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Ishikawa

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(45) **Date of Patent: Mar. 14, 2006**

(54) **COMMUNICATION TERMINAL DEVICE AND LENS ADAPTER**

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(73) Assignee: **Pioneer Corporation**, Tokyo-to (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 716 days.

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G02B 27/22 (2006.01)

(52) **U.S. Cl.** **359/462**; 359/811; 359/819; 348/51; 345/32; 349/15

(58) **Field of Classification Search** 359/626, 359/619, 620–622, 462, 477, 478, 811, 818, 359/819; 345/31, 32, 7; 348/14.02, 44, 348/51, 54; 349/15, 31, 32
See application file for complete search history.

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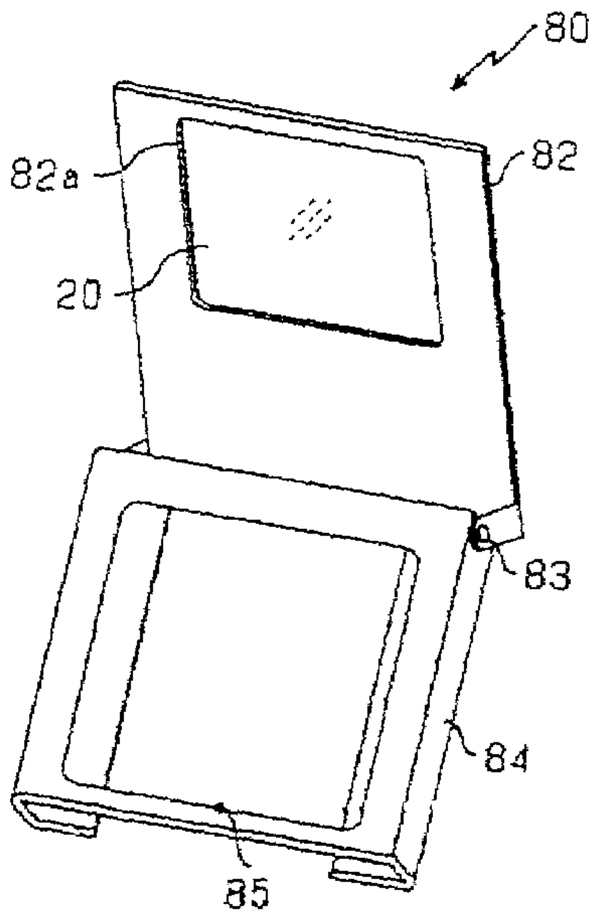
(57) **ABSTRACT**

The display unit displays two-dimensional picture. When the panel unit is at the first position, the microlens unit confronts the display unit with the spacing substantially equal to the focal length of the microlens unit. Therefore, the two-dimensional picture is visualized as a pseudo-stereoscopic picture. On the other hand, when the panel unit is at the second position, the microlens unit does not confront the display unit, and hence a user can directly see the two-dimensional picture on the display unit.

4 Claims, 25 Drawing Sheets



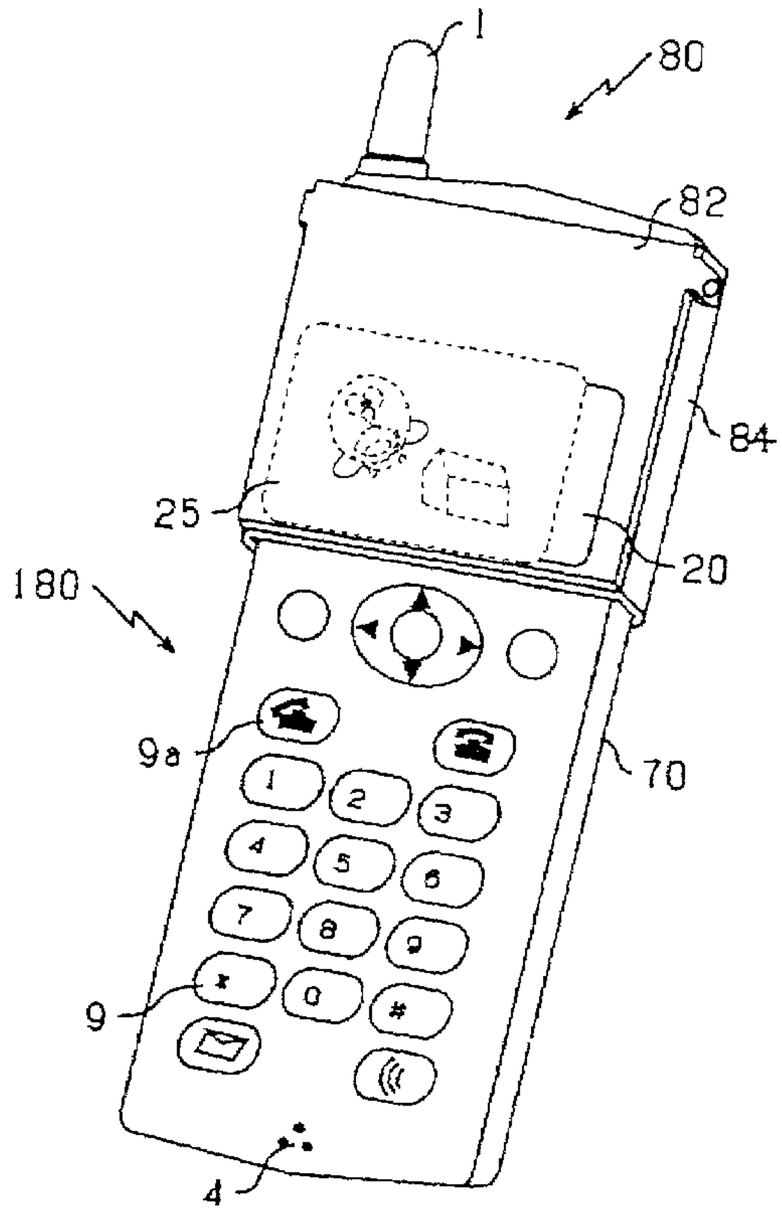


FIG. 1

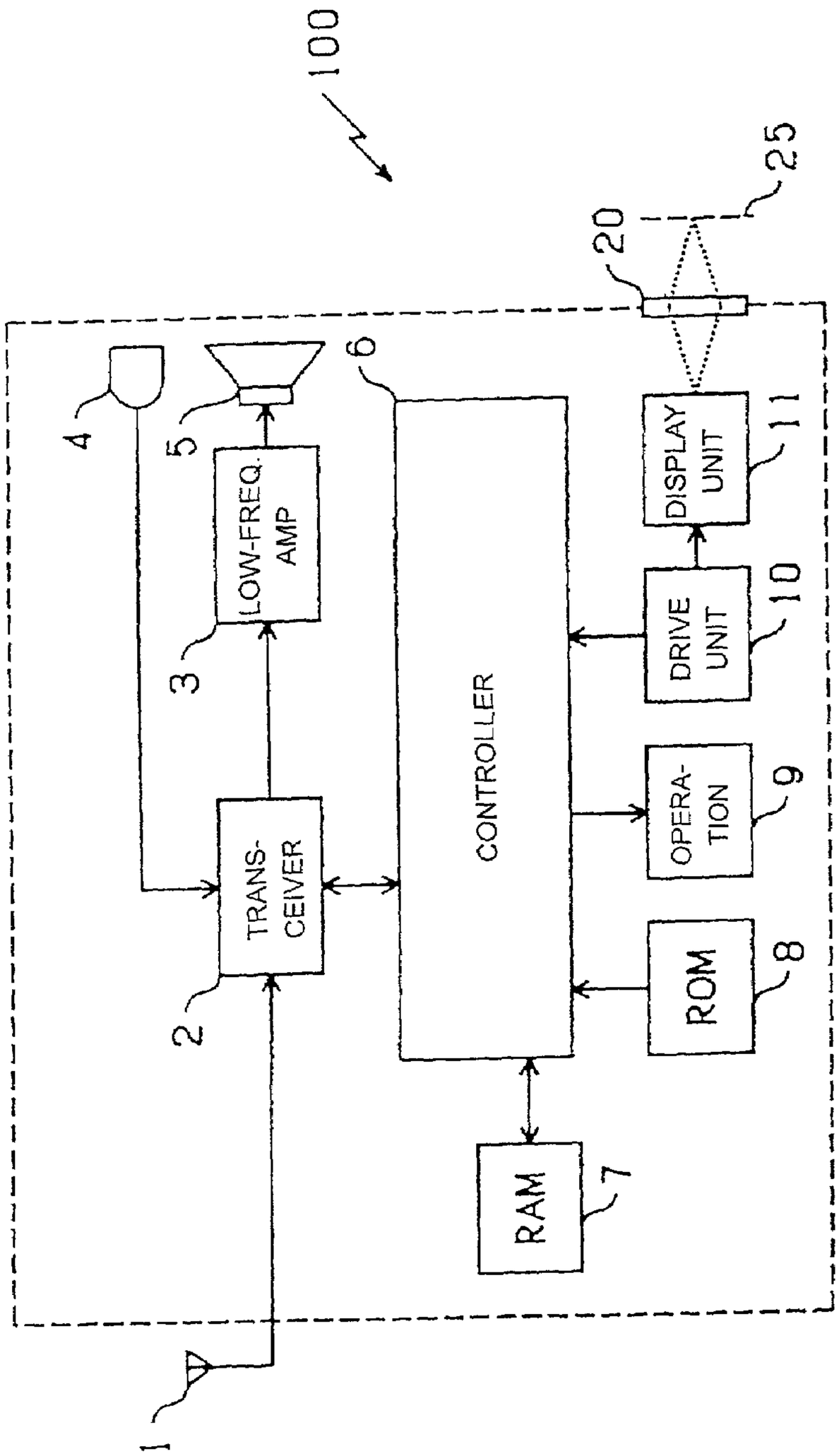

100
20
25
4
5
6
LOW-FREQ. AMP
3
DISPLAY UNIT
11
CONTROLLER
DRIVE UNIT
10
TRANS-CEIVER
2
OPERA-TION
9
ROM
8
RAM
7
1

FIG. 2

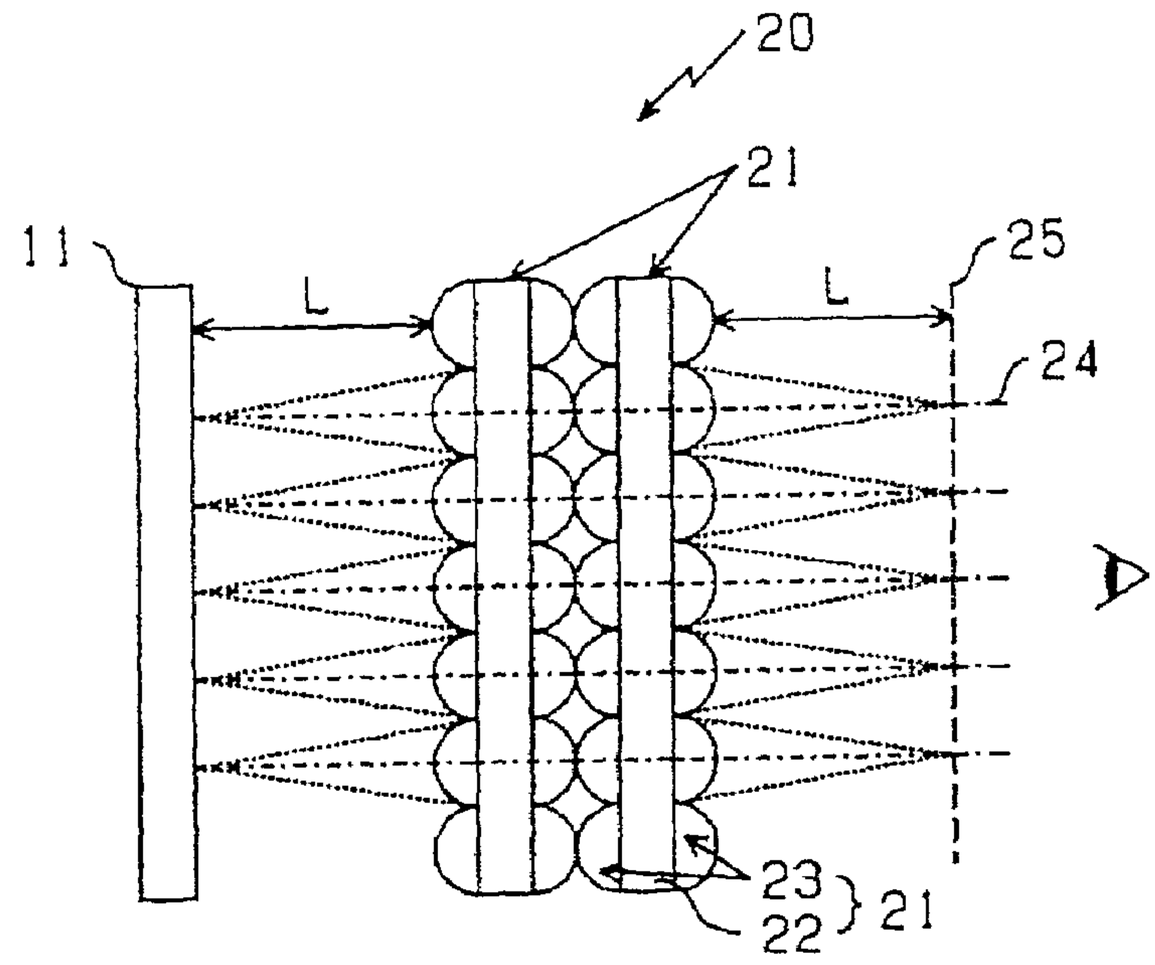


FIG.3

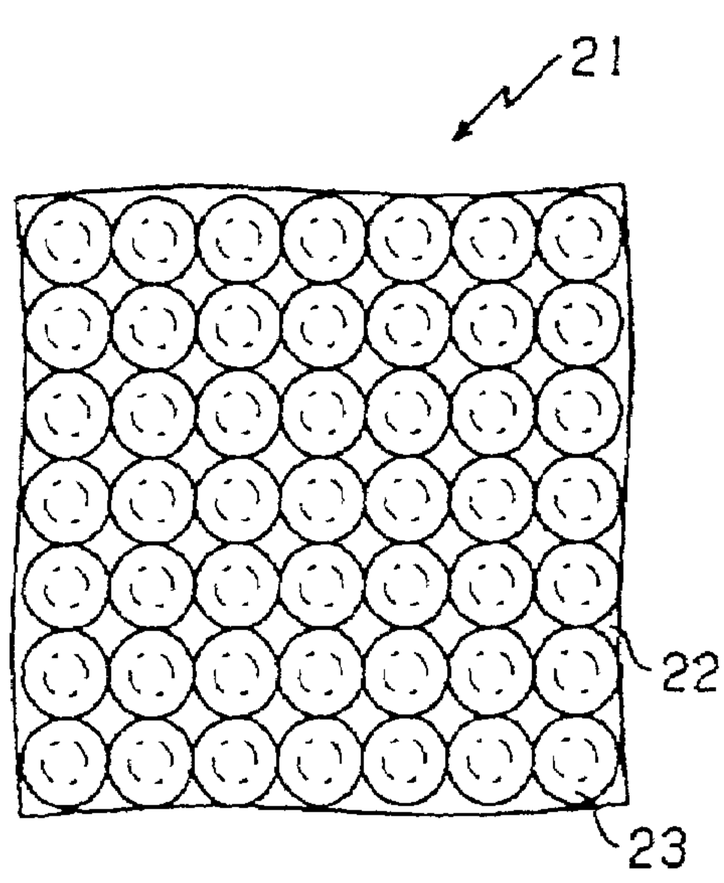


FIG. 4

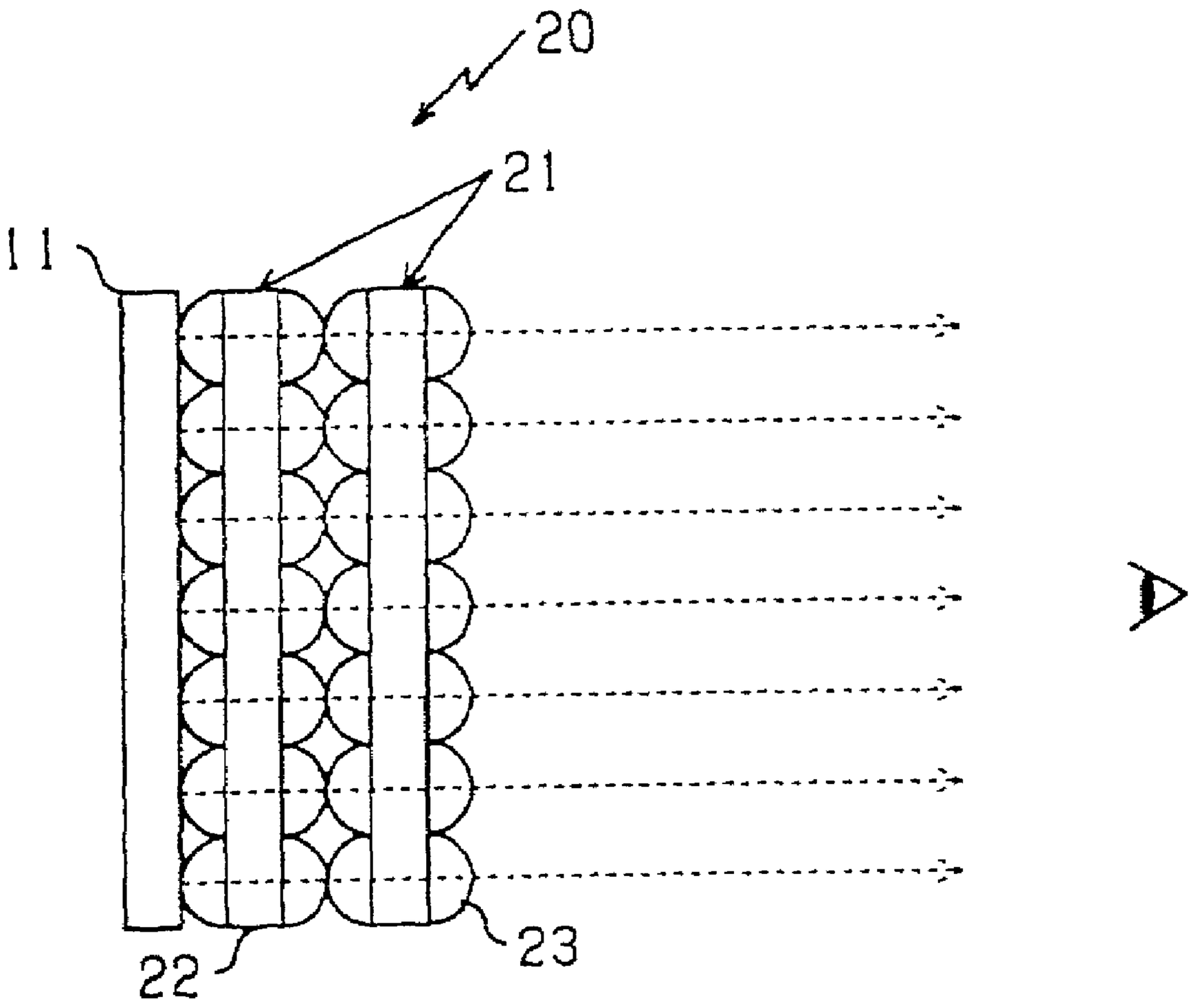


FIG. 5

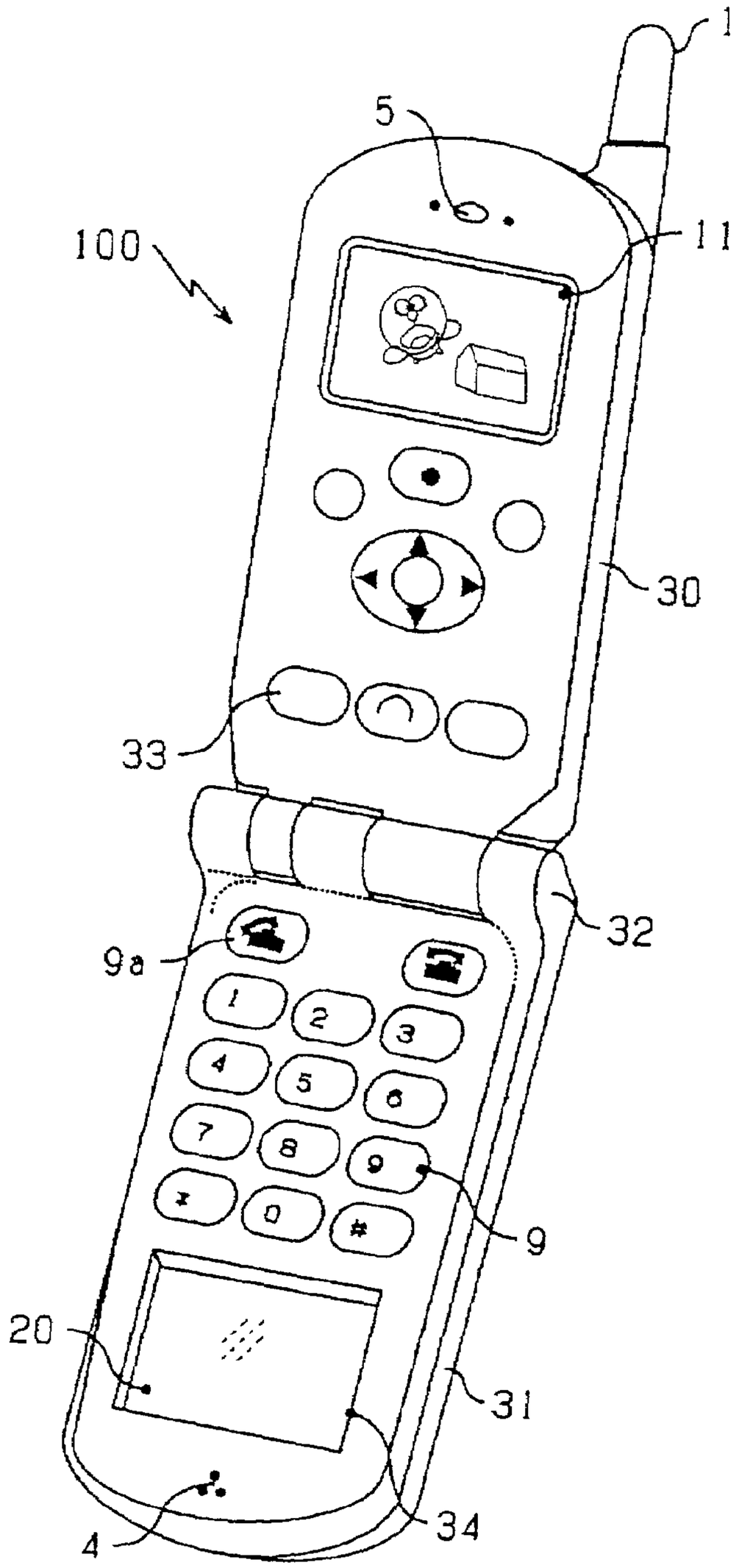


FIG. 6

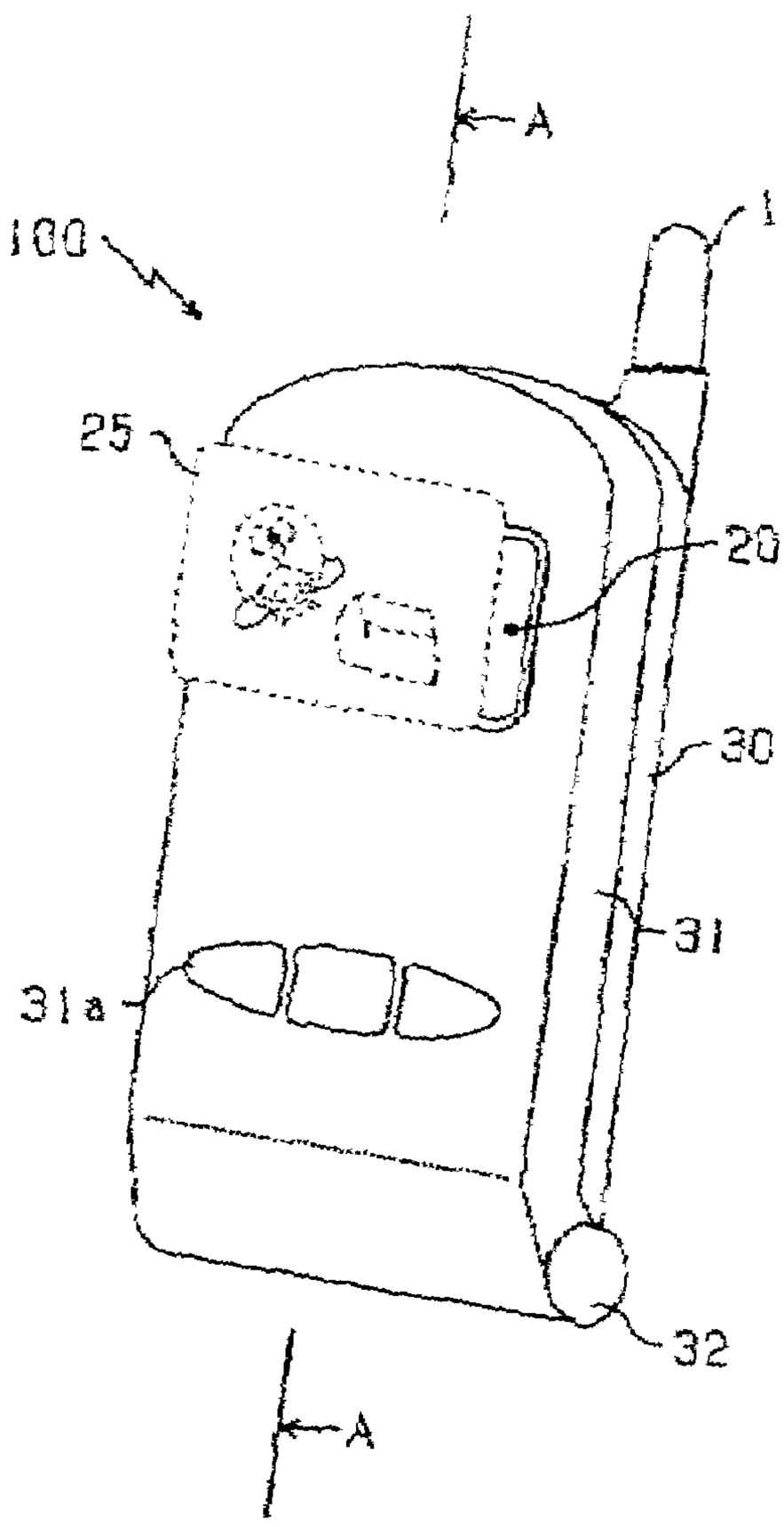


FIG. 7

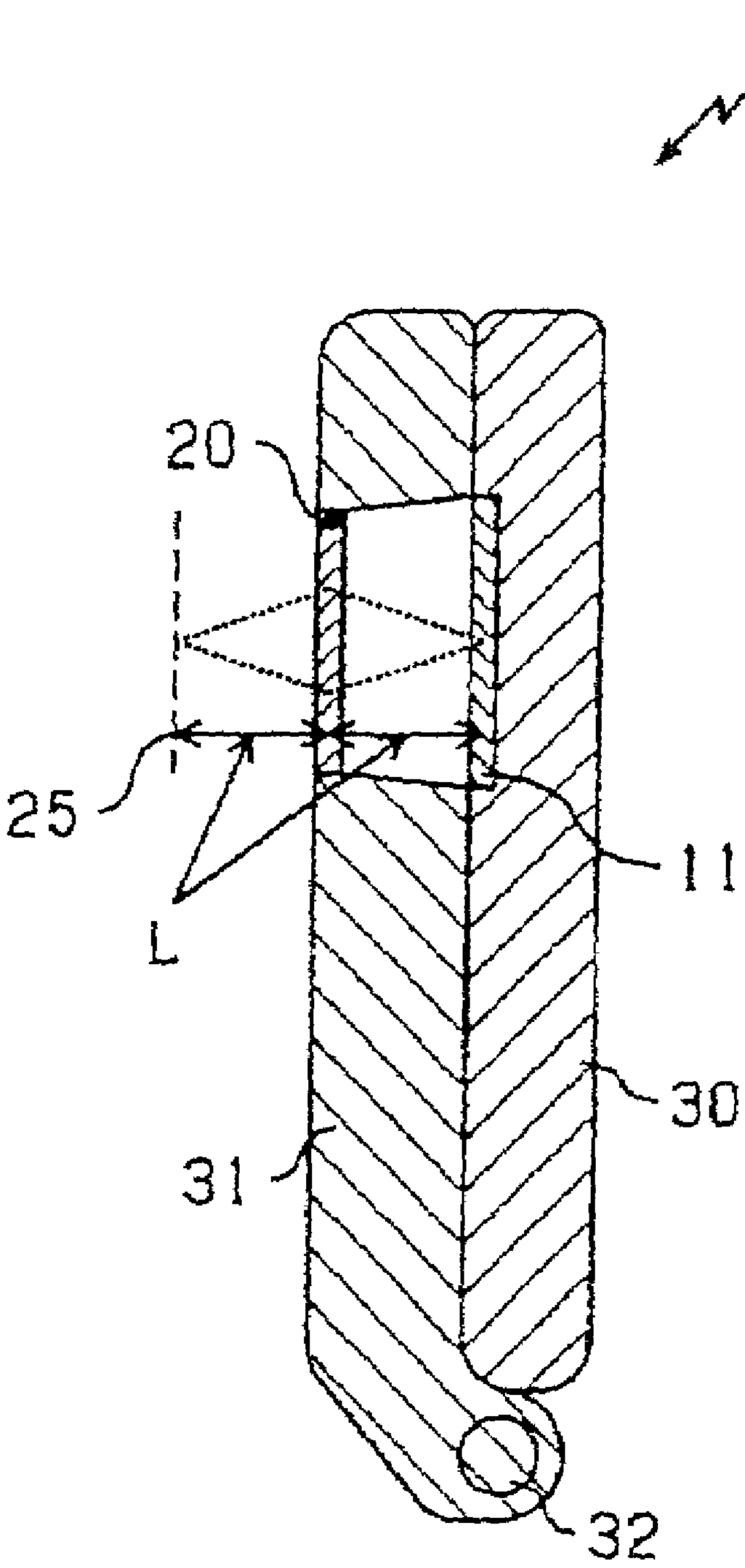


FIG.8

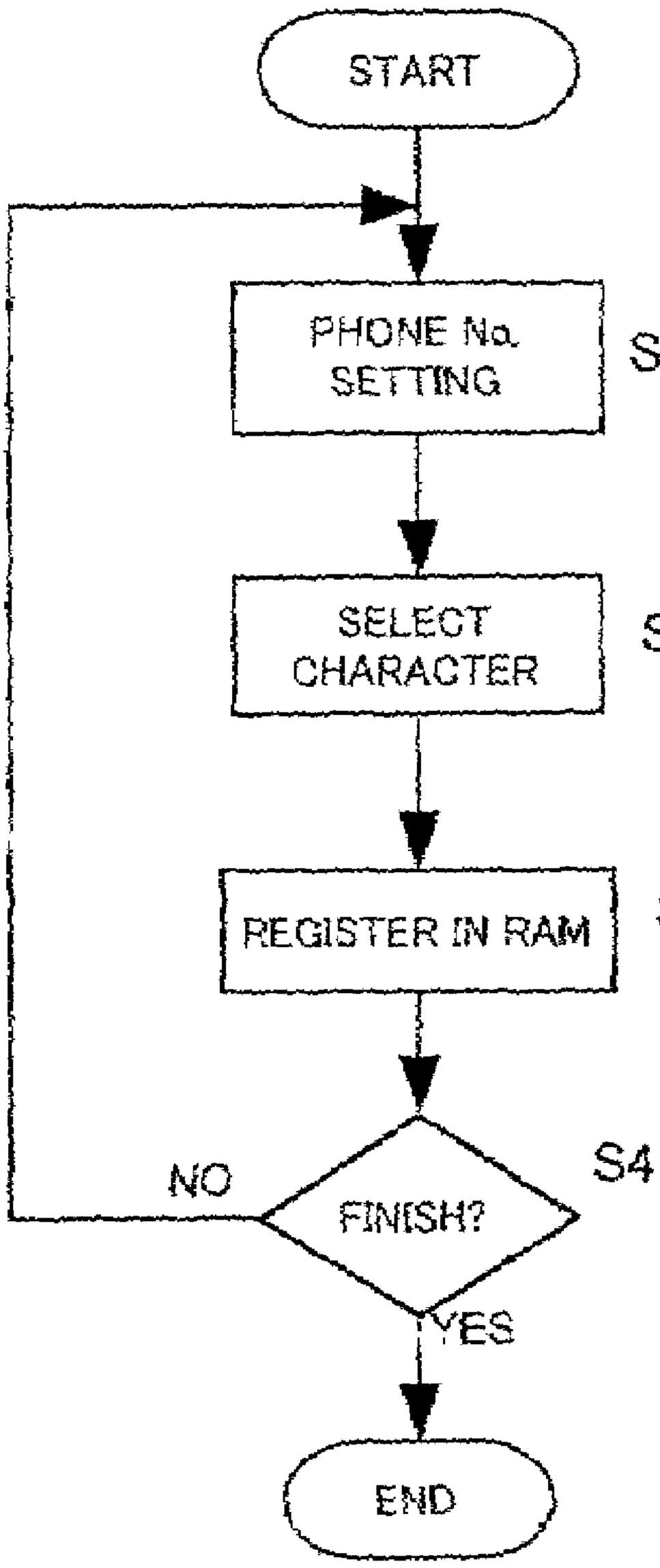

START
PHONE No. SETTING
S1
SELECT CHARACTER
S2
REGISTER IN RAM
S3
FINISH?
S4
NO
YES
END

FIG.9

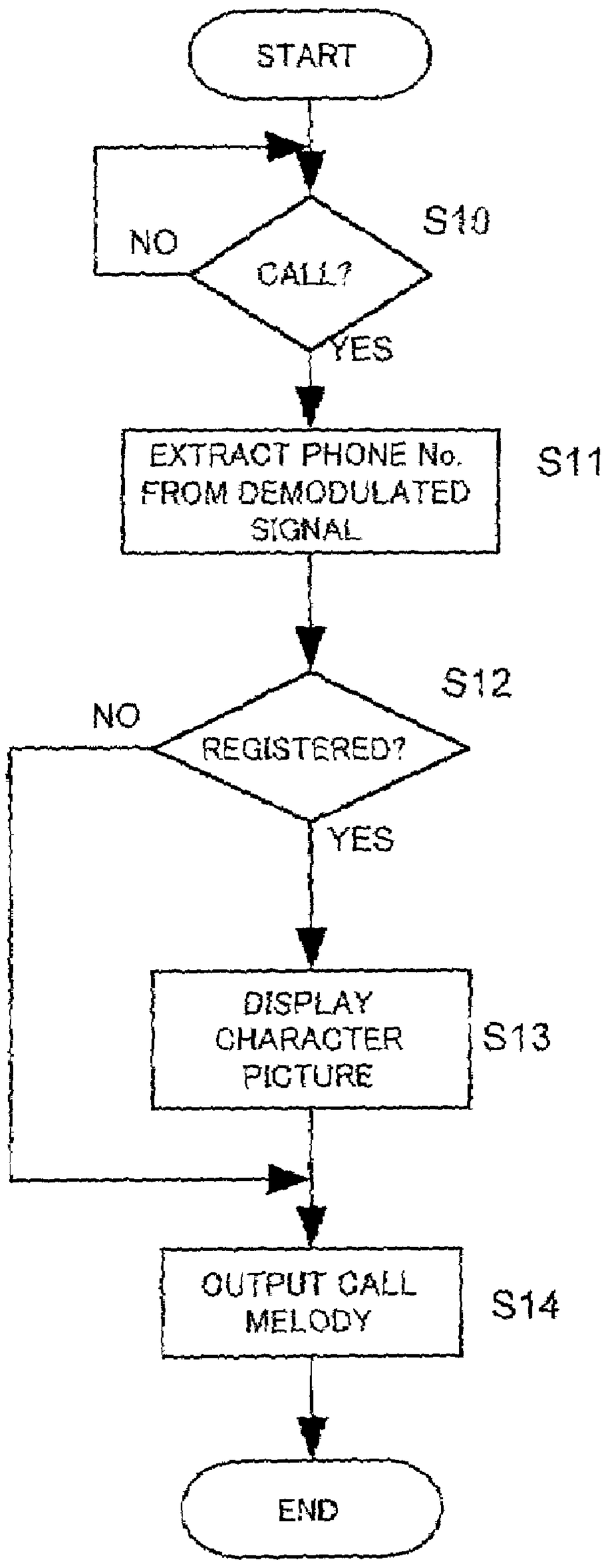

START
S10
NO
CALL?
YES
EXTRACT PHONE No. FROM DEMODULATED SIGNAL
S11
S12
NO
REGISTERED?
YES
DISPLAY CHARACTER PICTURE
S13
OUTPUT CALL MELODY
S14
END

FIG. 10

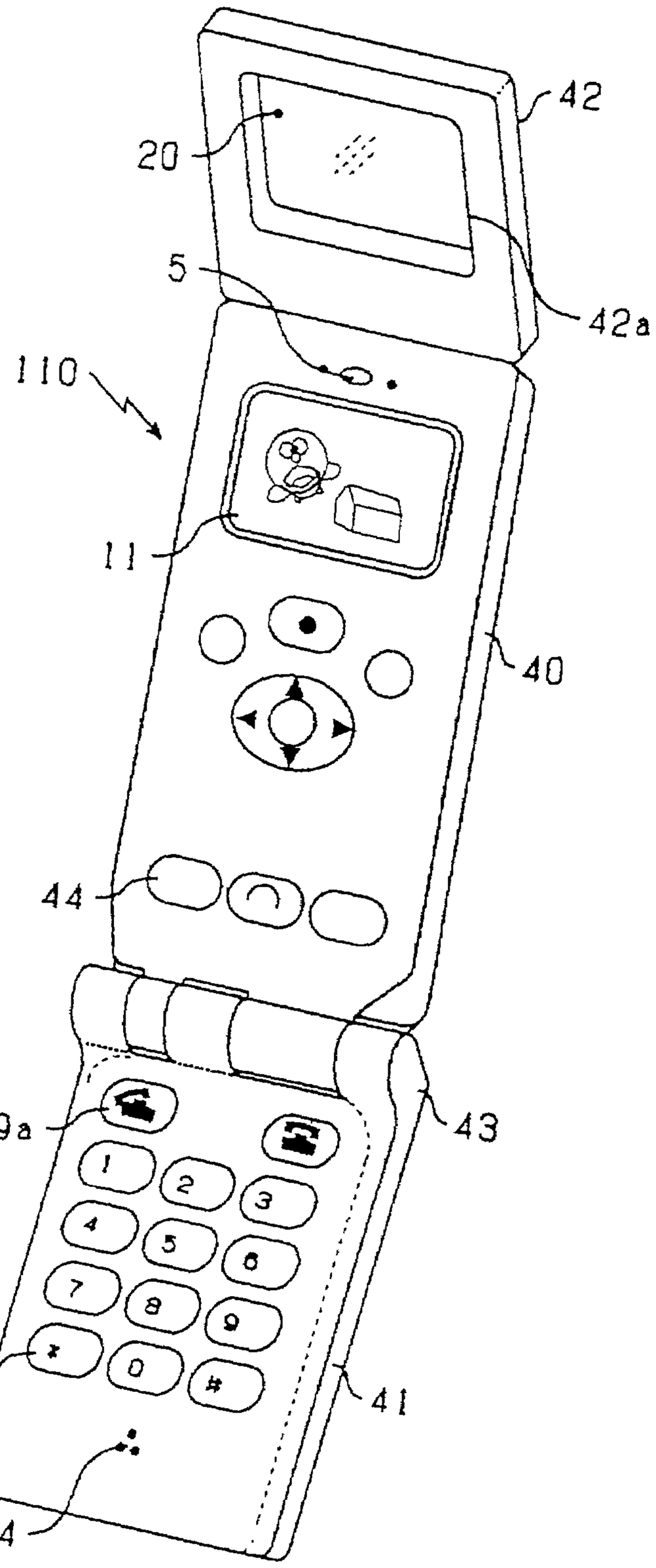


FIG. 11

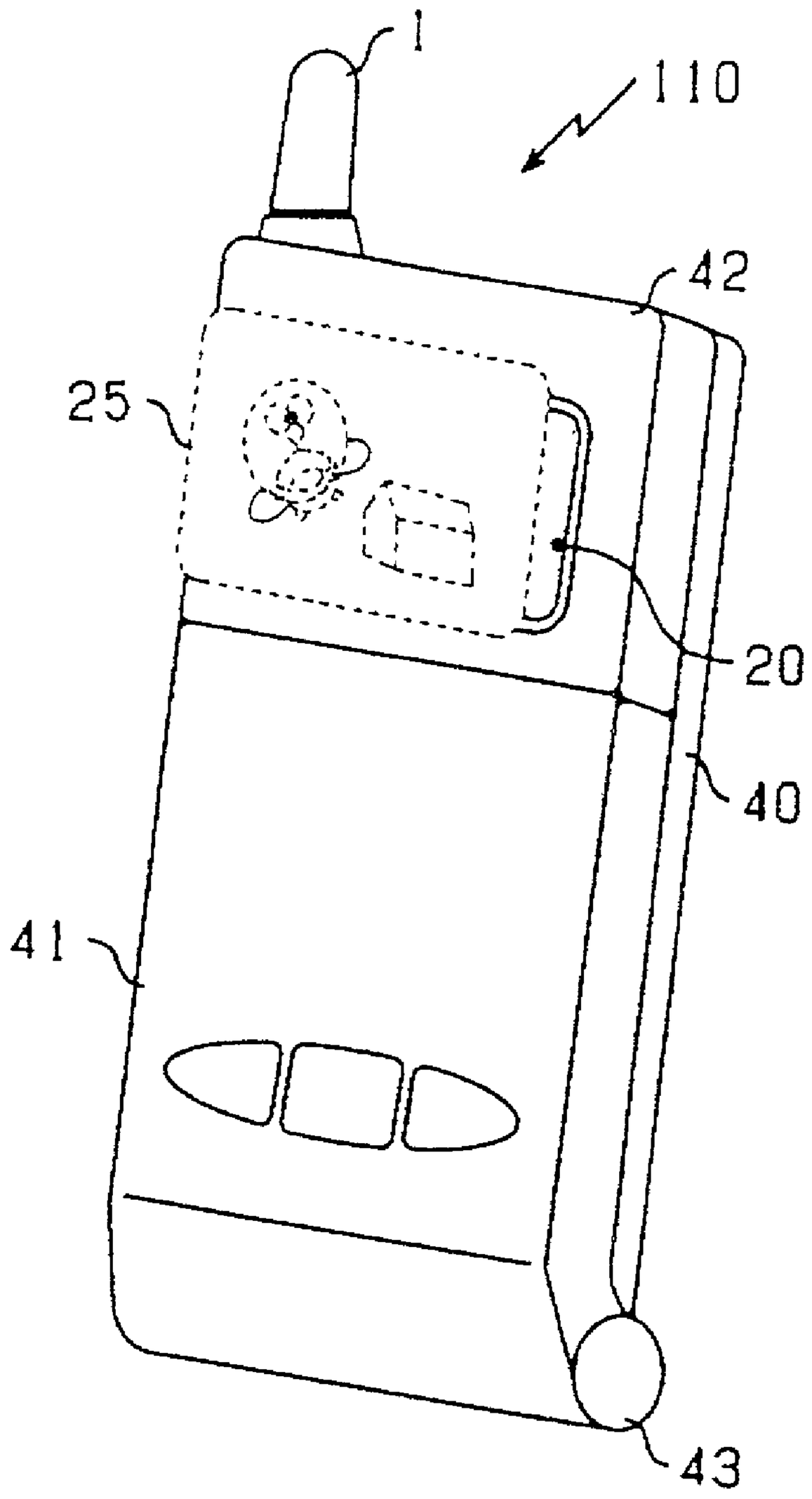


FIG. 12

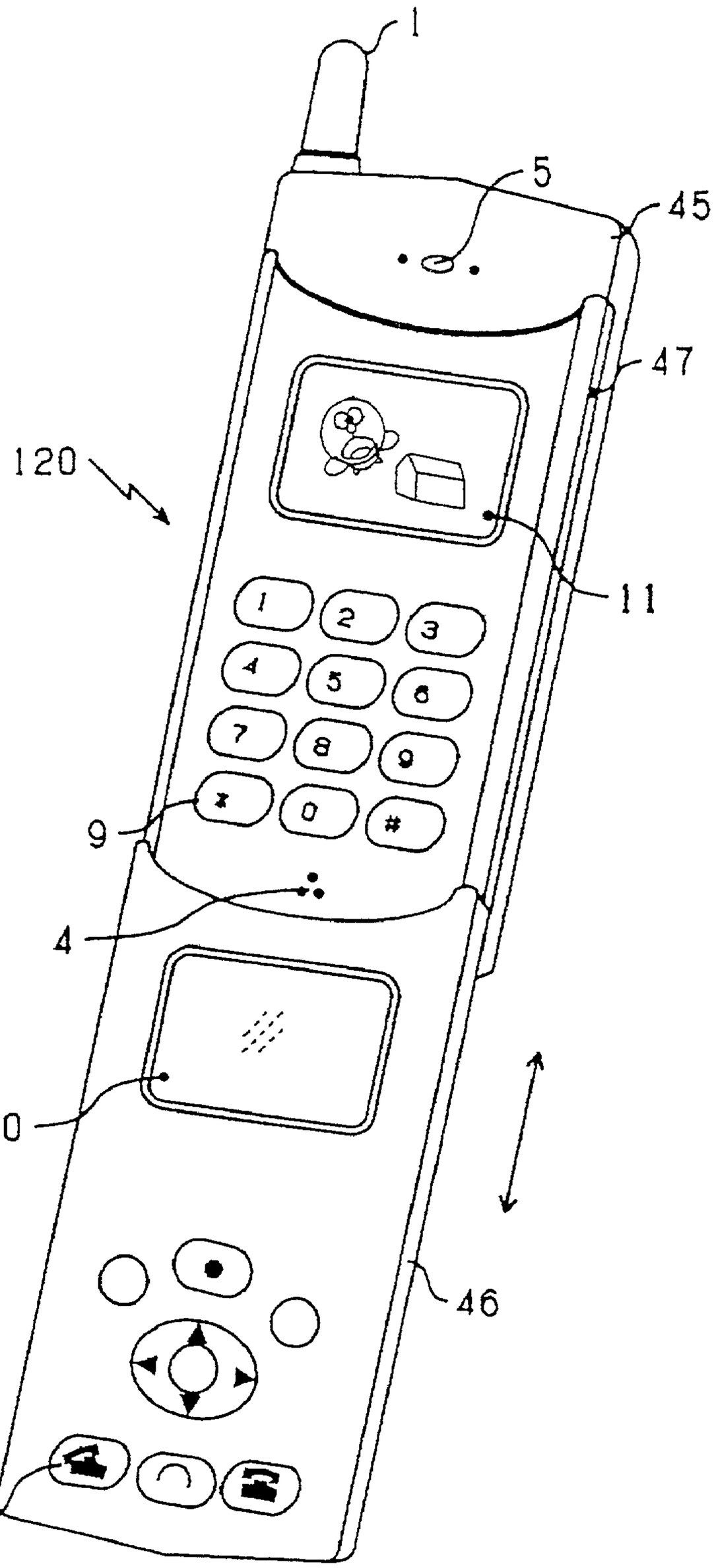


FIG.13

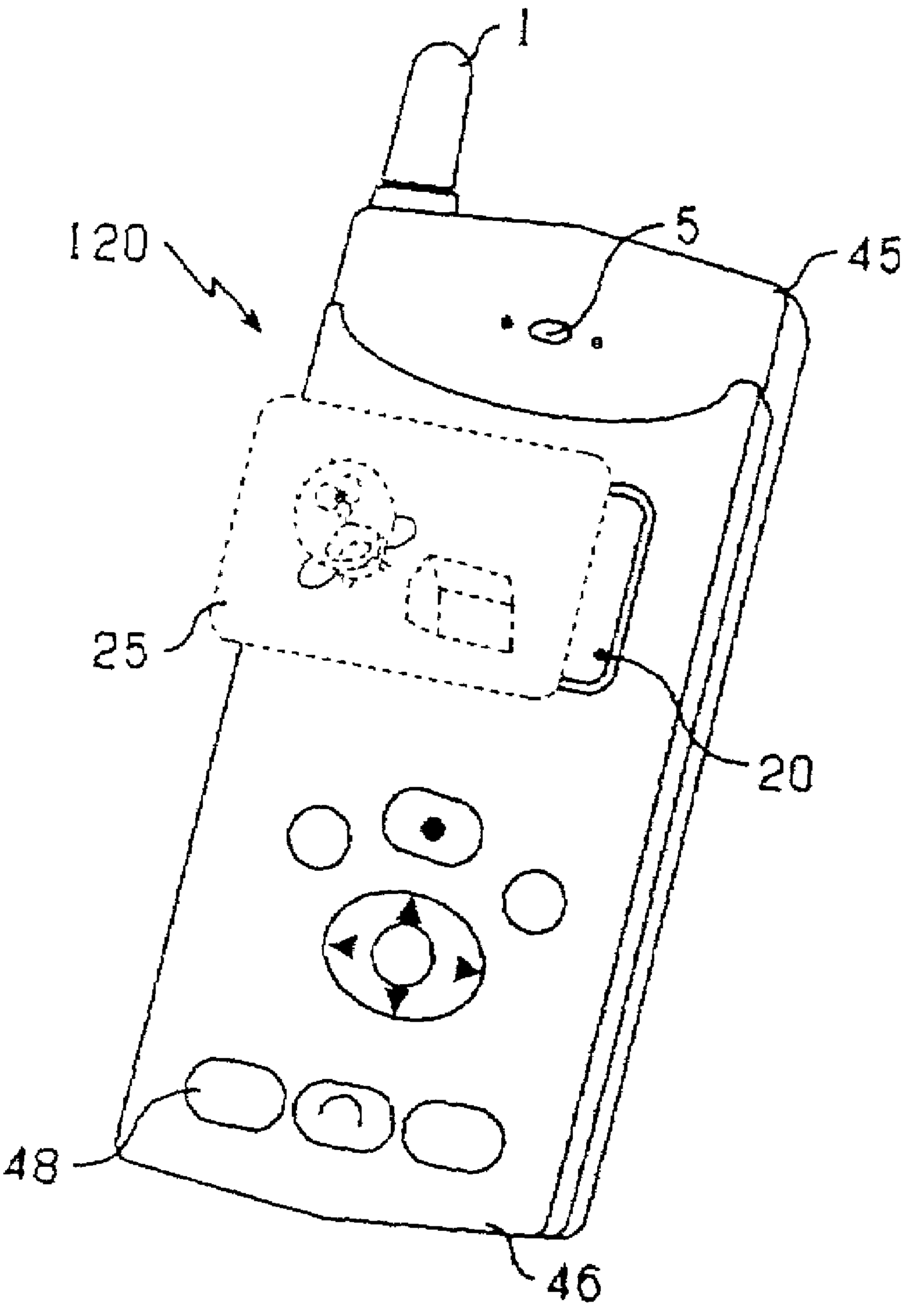


FIG. 14

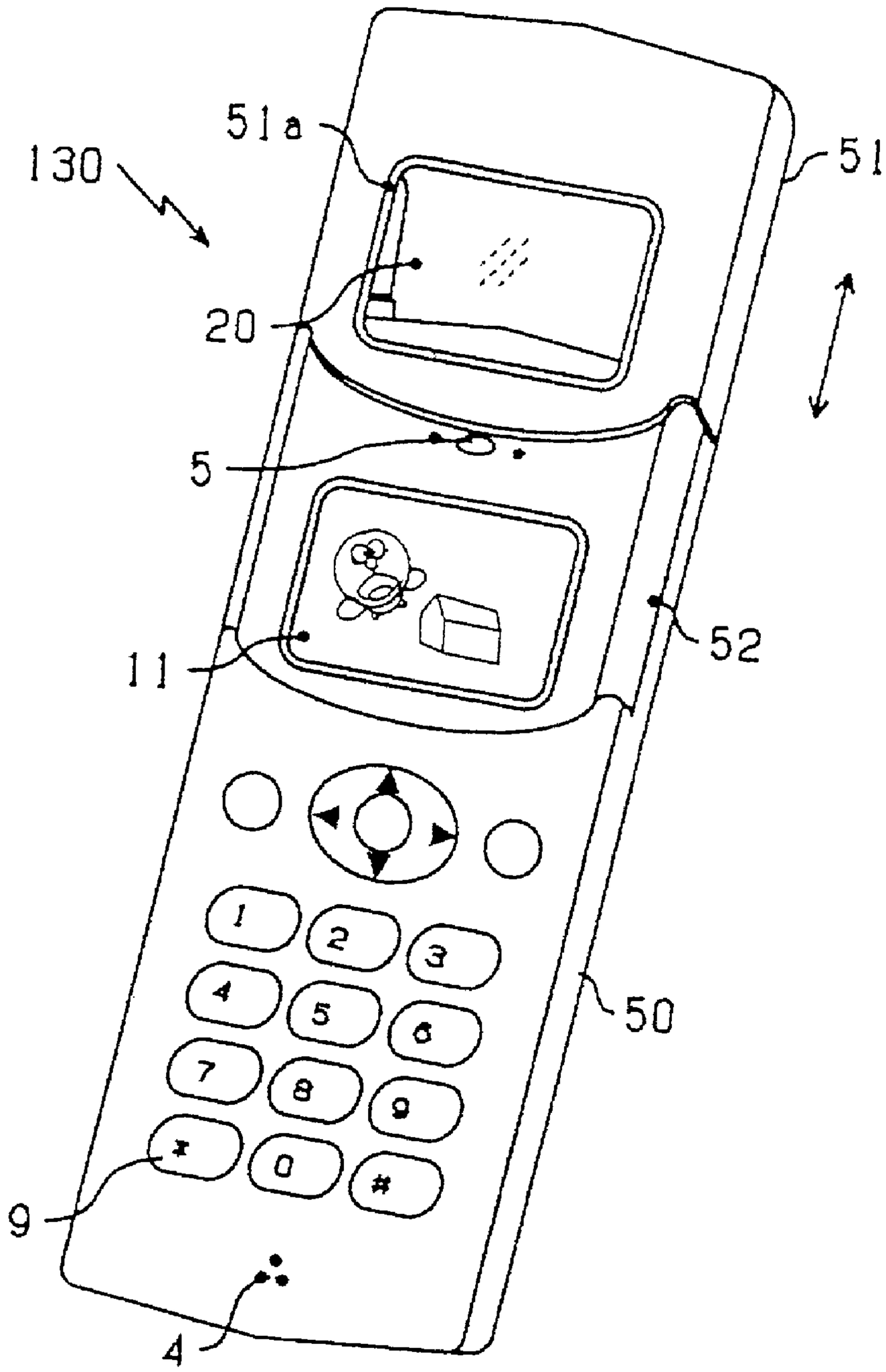


FIG. 15

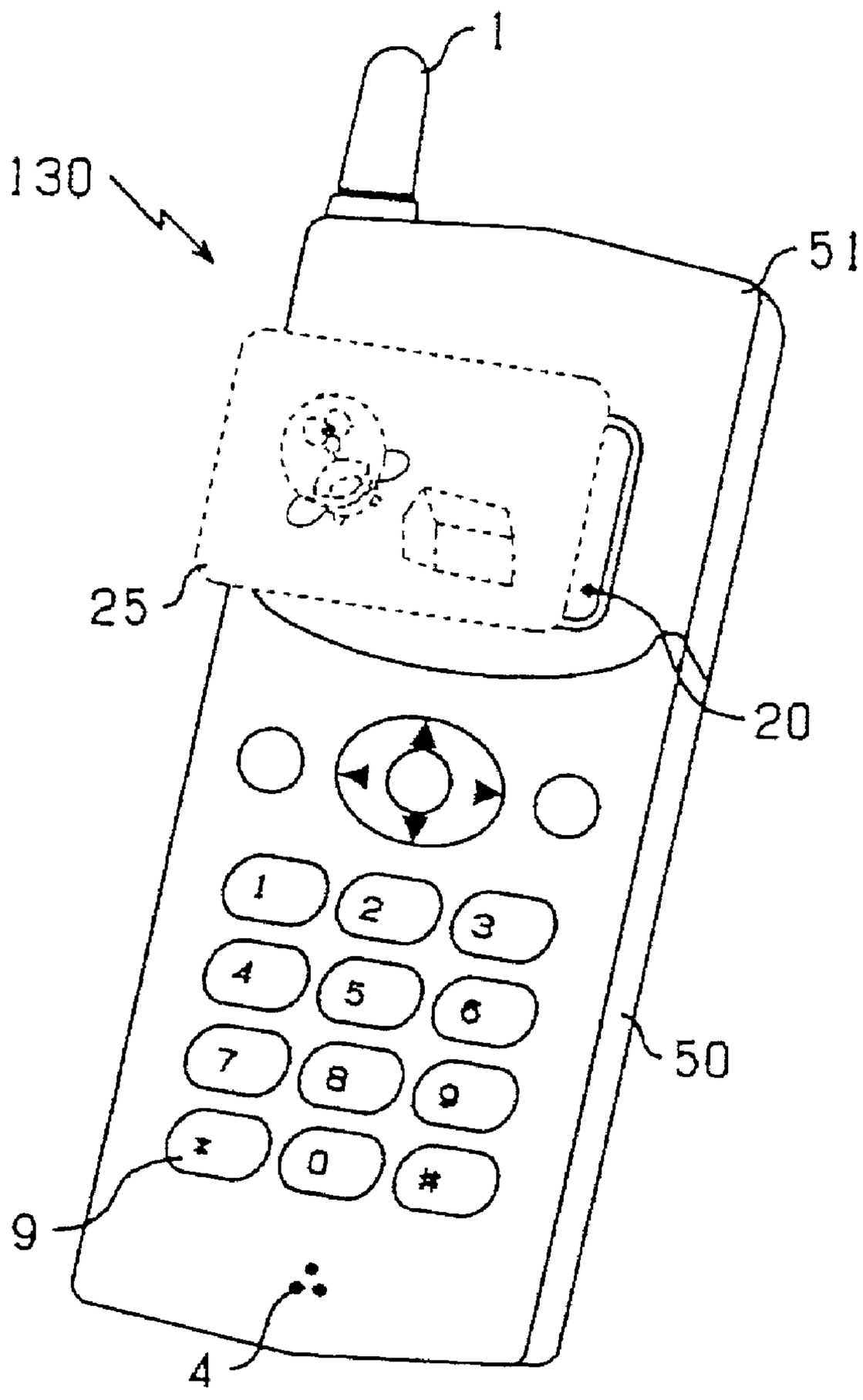


FIG. 16

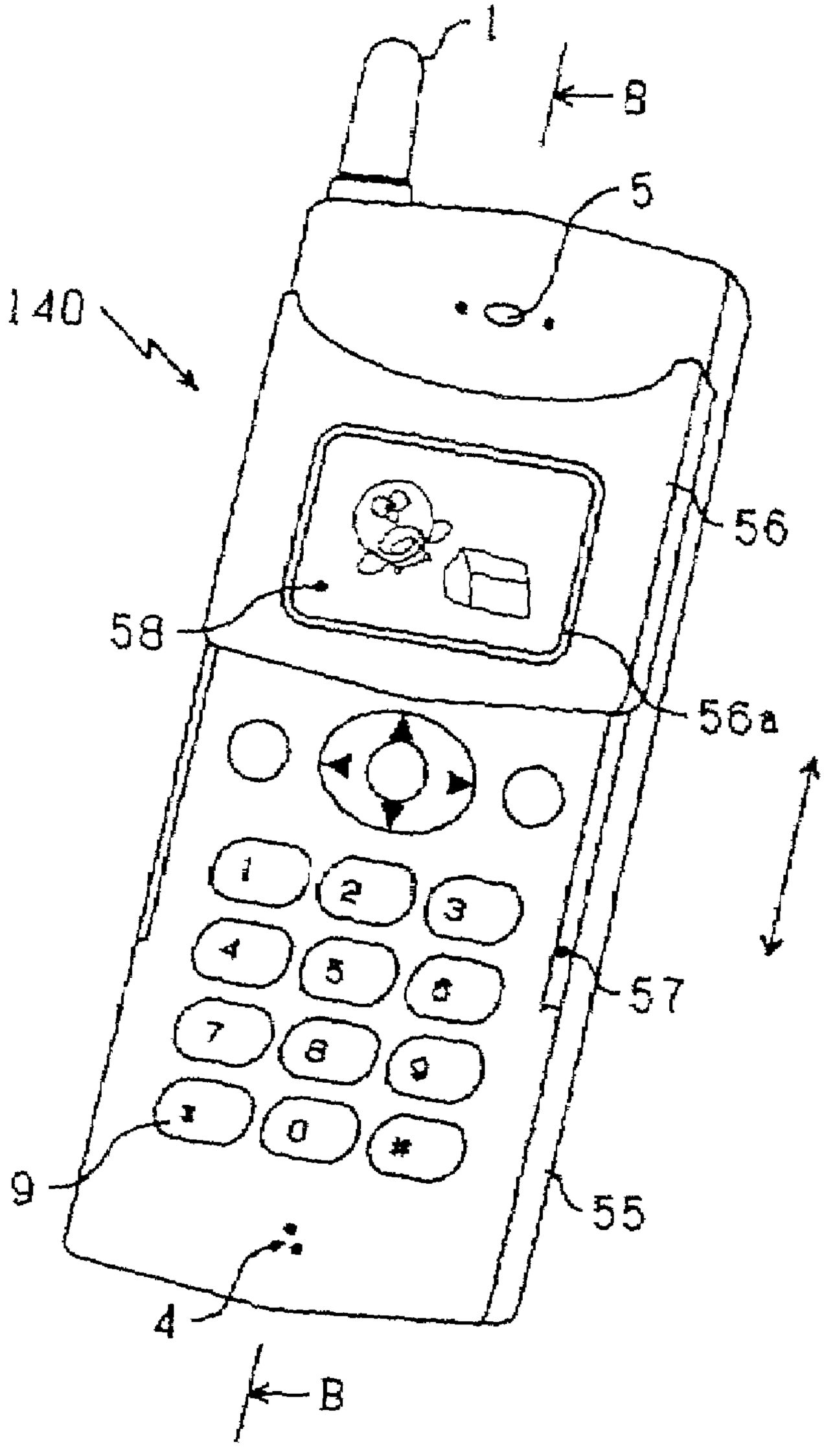


FIG. 17

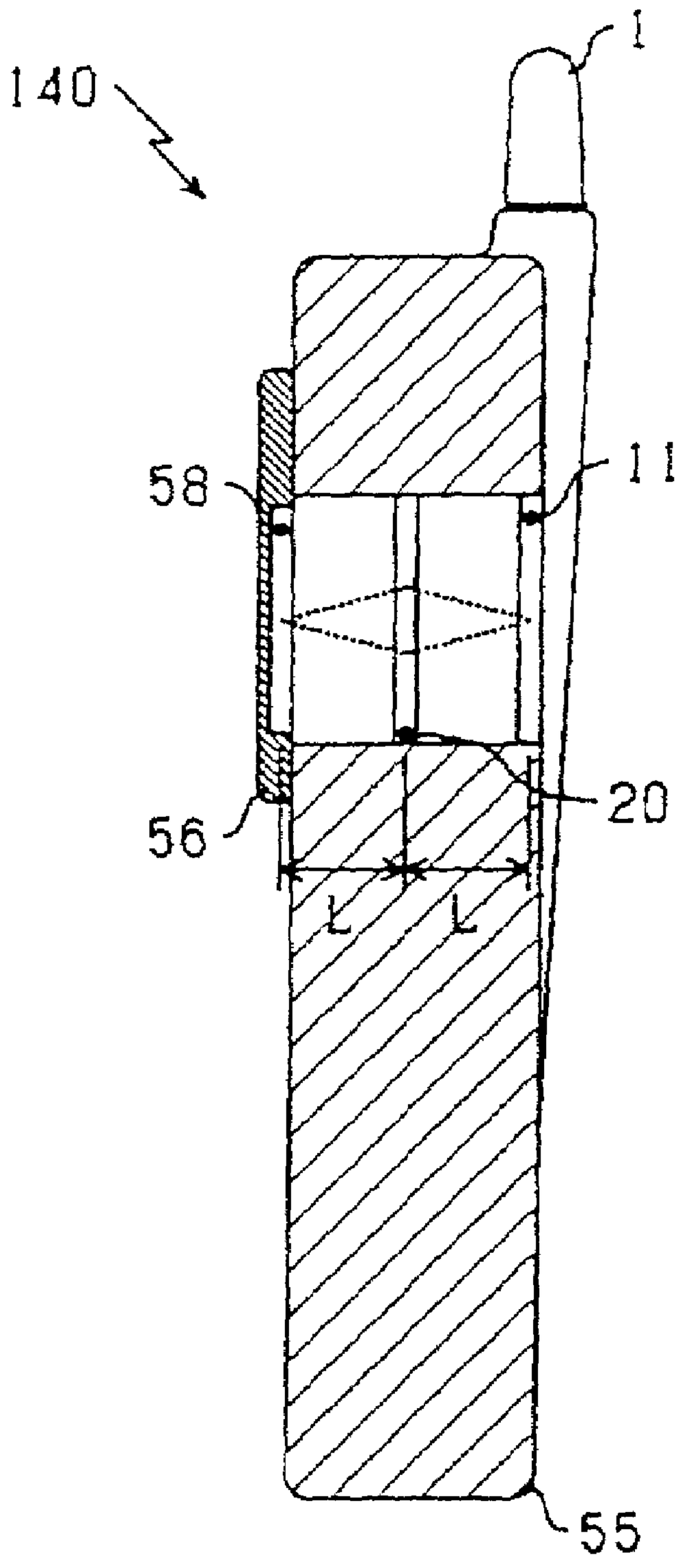


FIG. 18

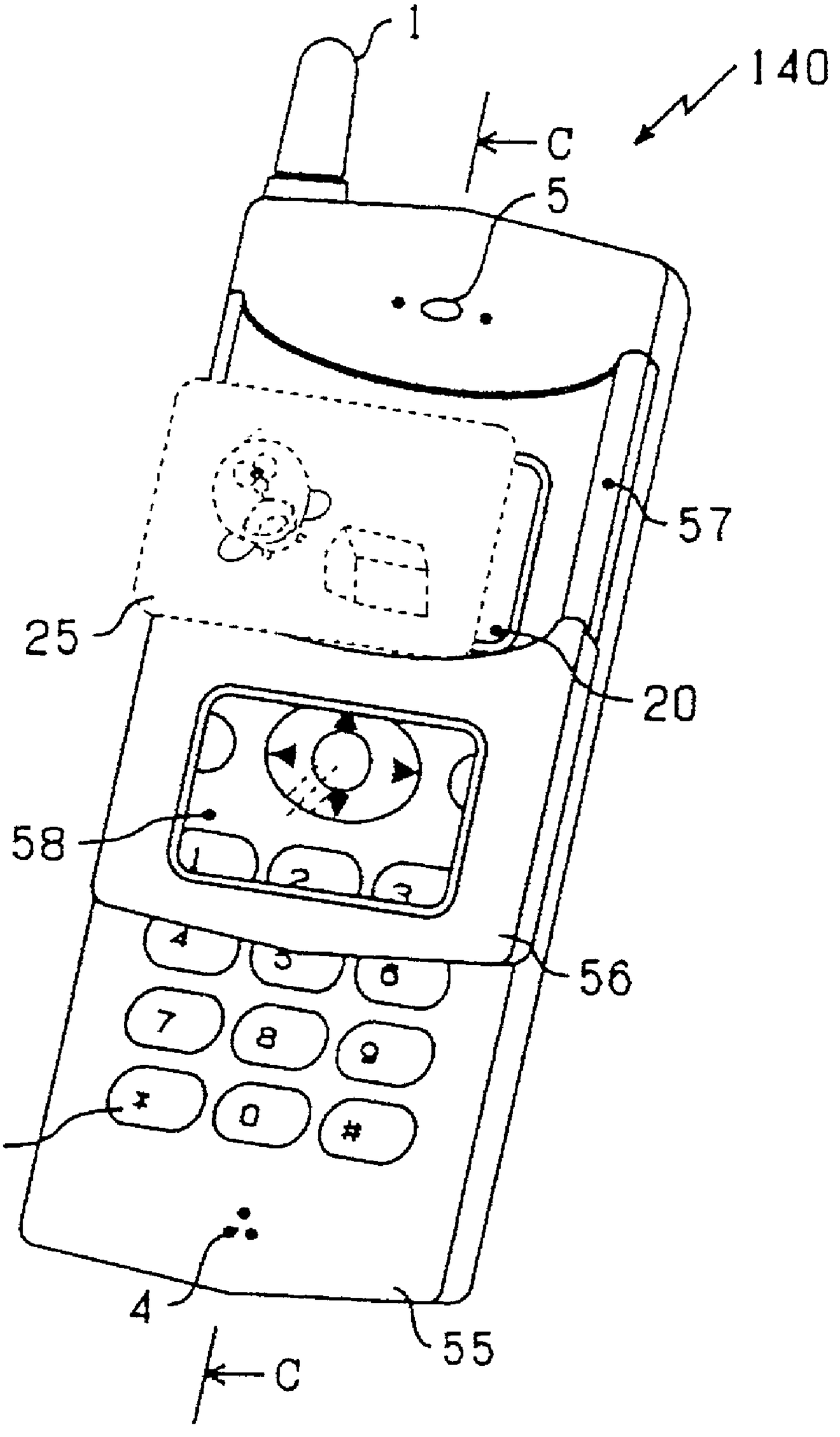


FIG. 19

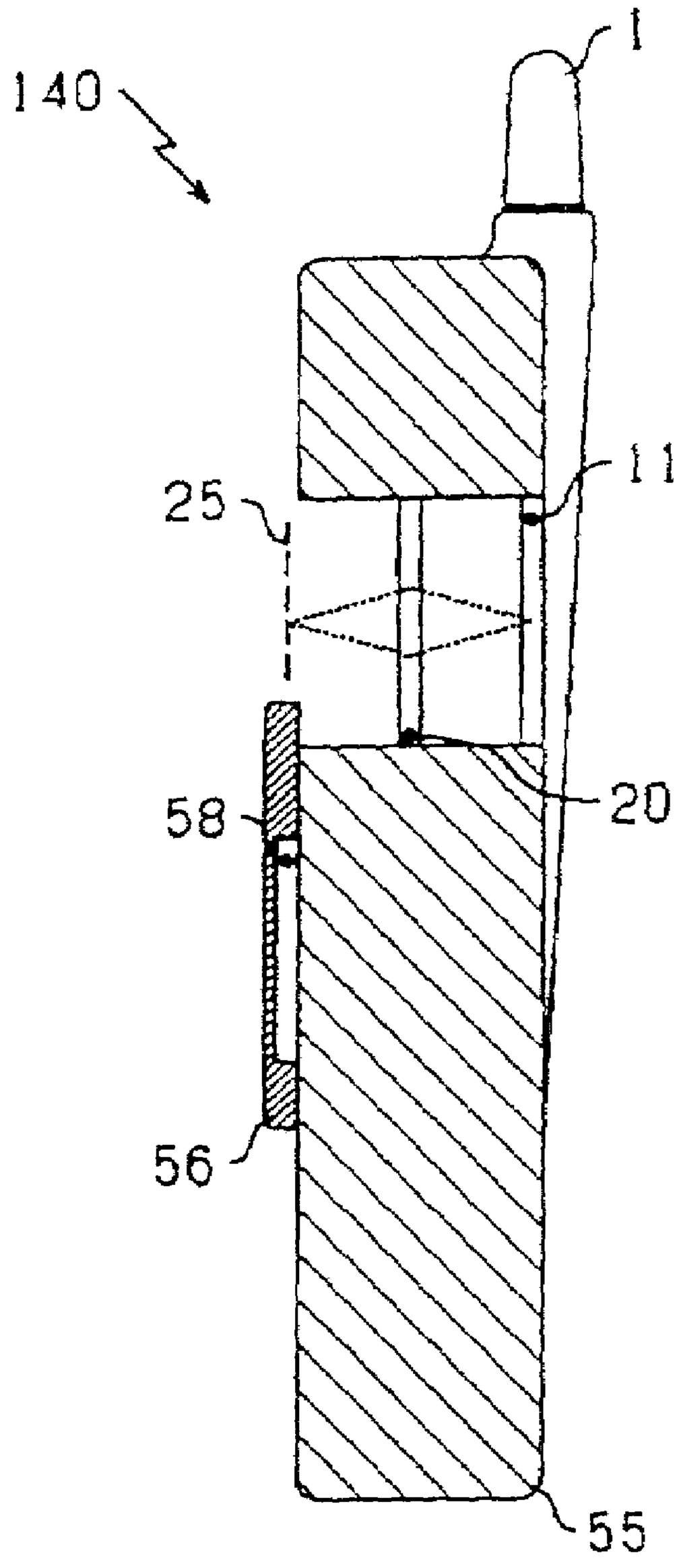


FIG. 20

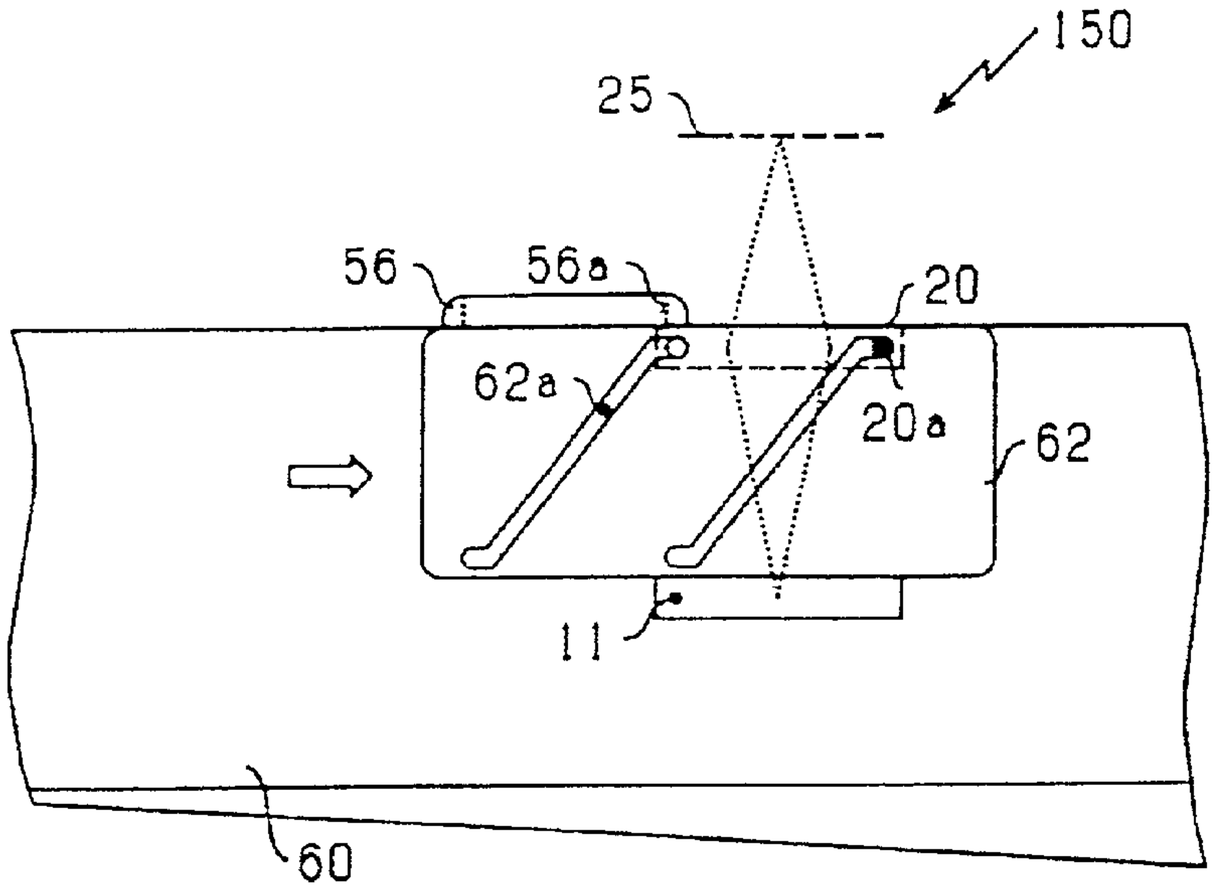


FIG. 21

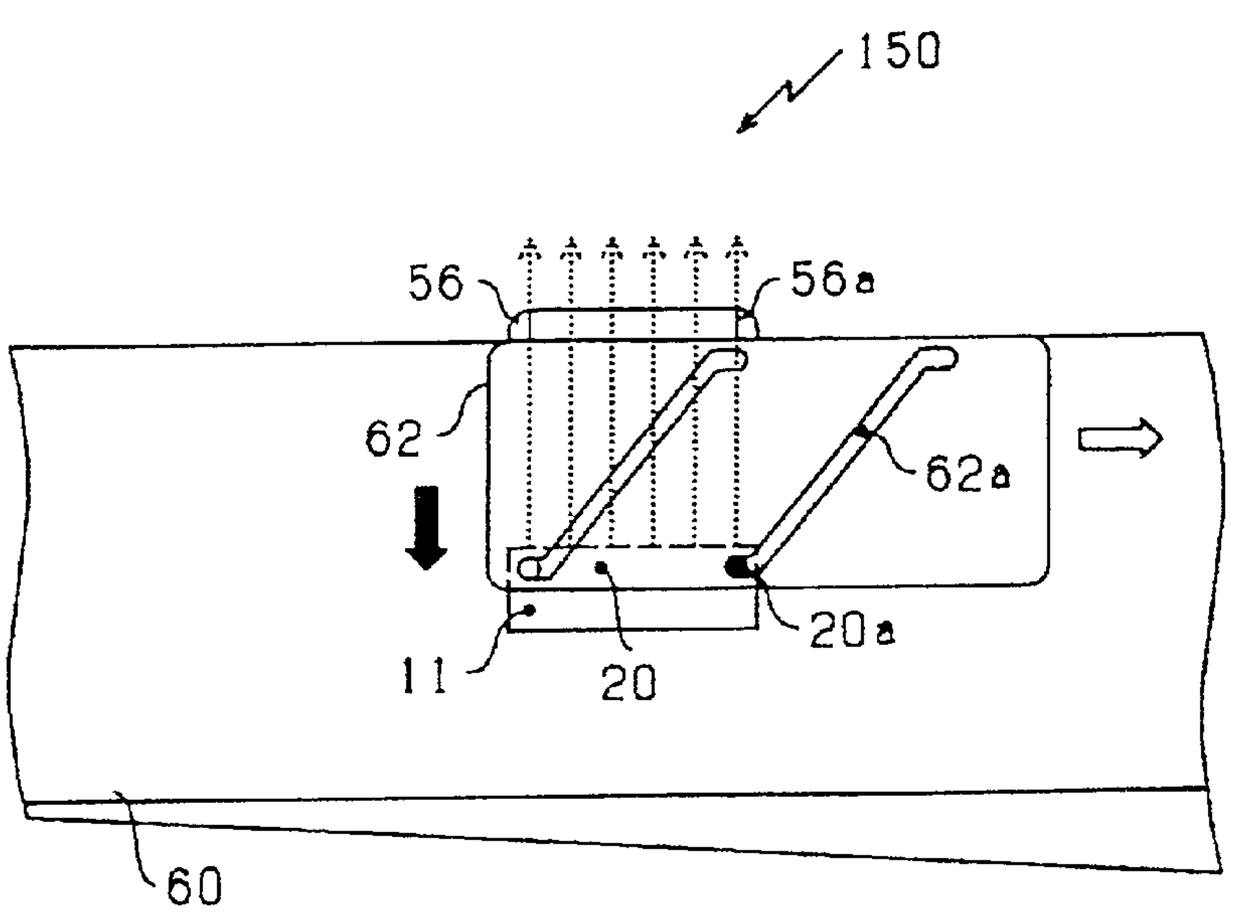


FIG. 22

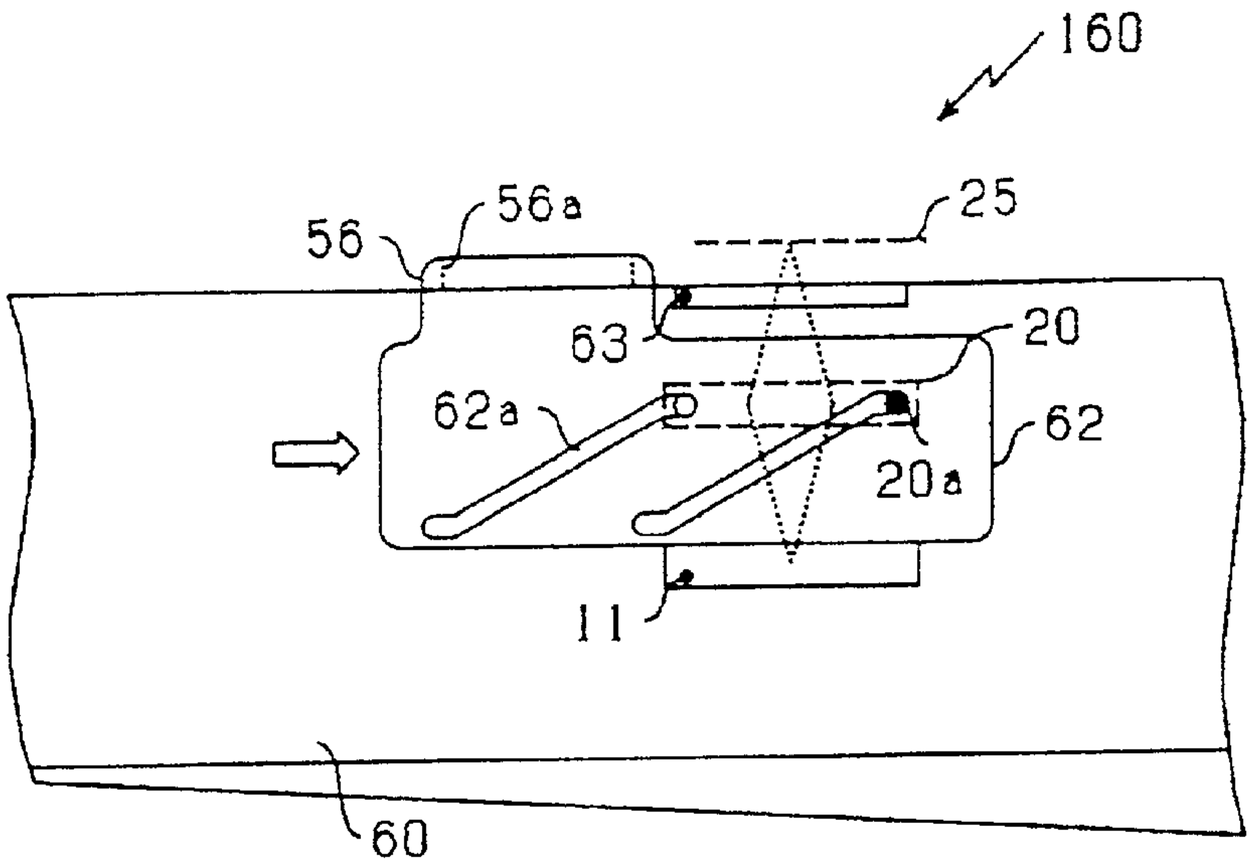

160
56
56a
25
63
20
62a
62
20a
11
60

FIG.23

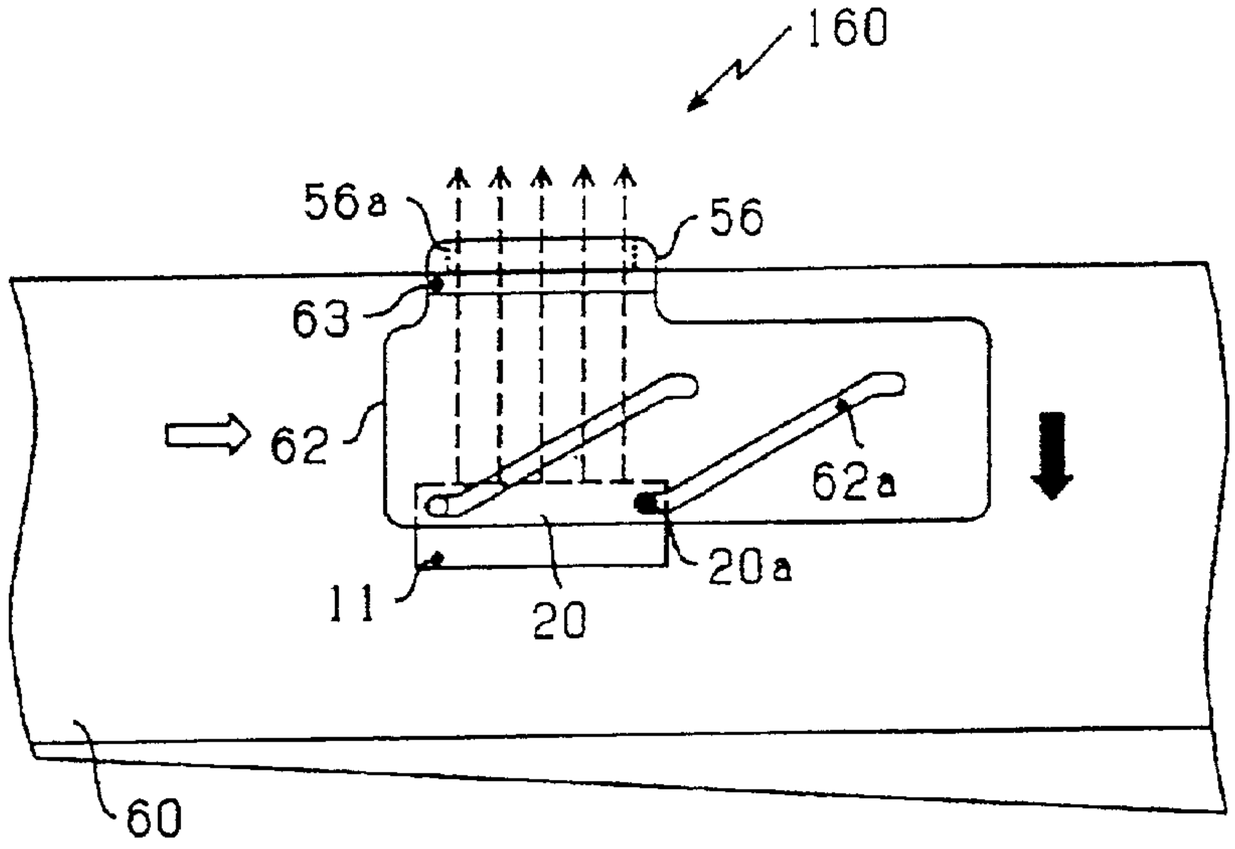

160
56a
56
63
62
62a
20a
11
20
60

FIG. 24

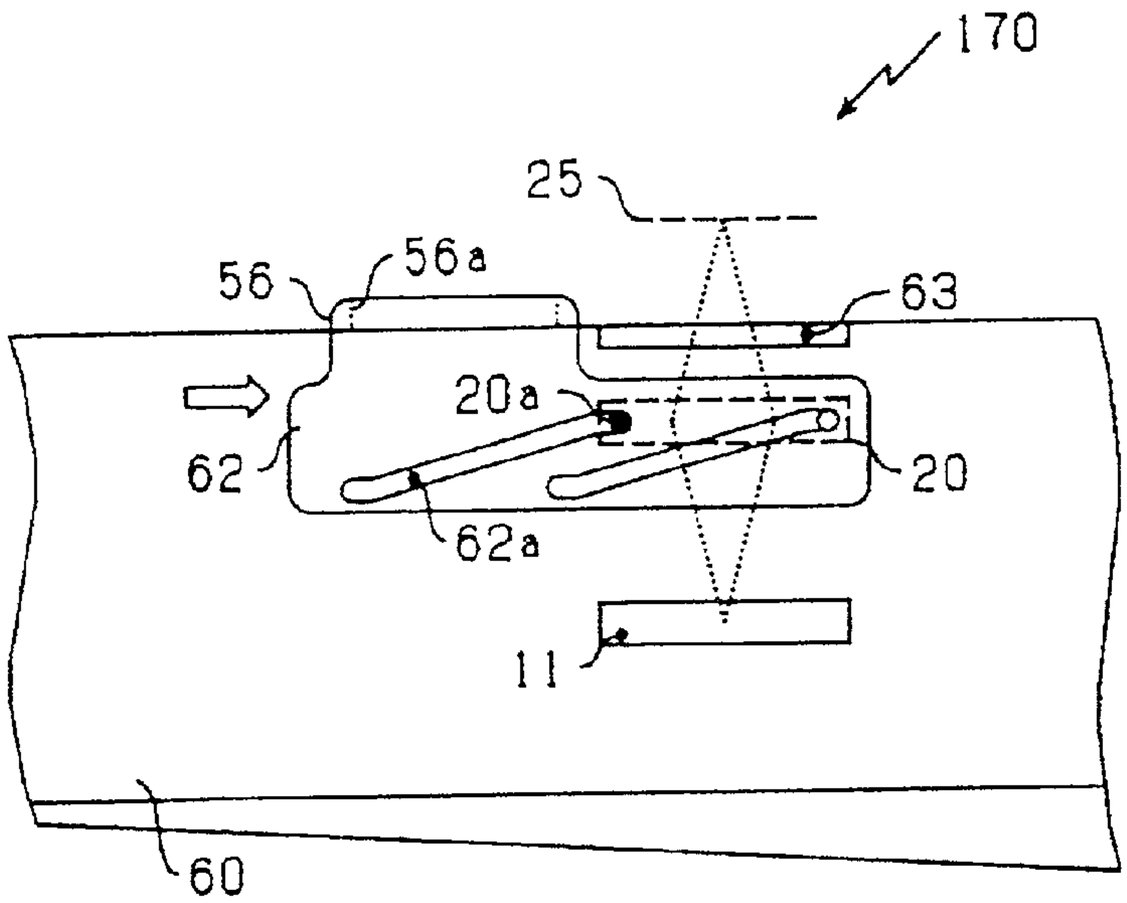

170
25
56
56a
63
20a
62
20
62a
11
60

FIG. 25

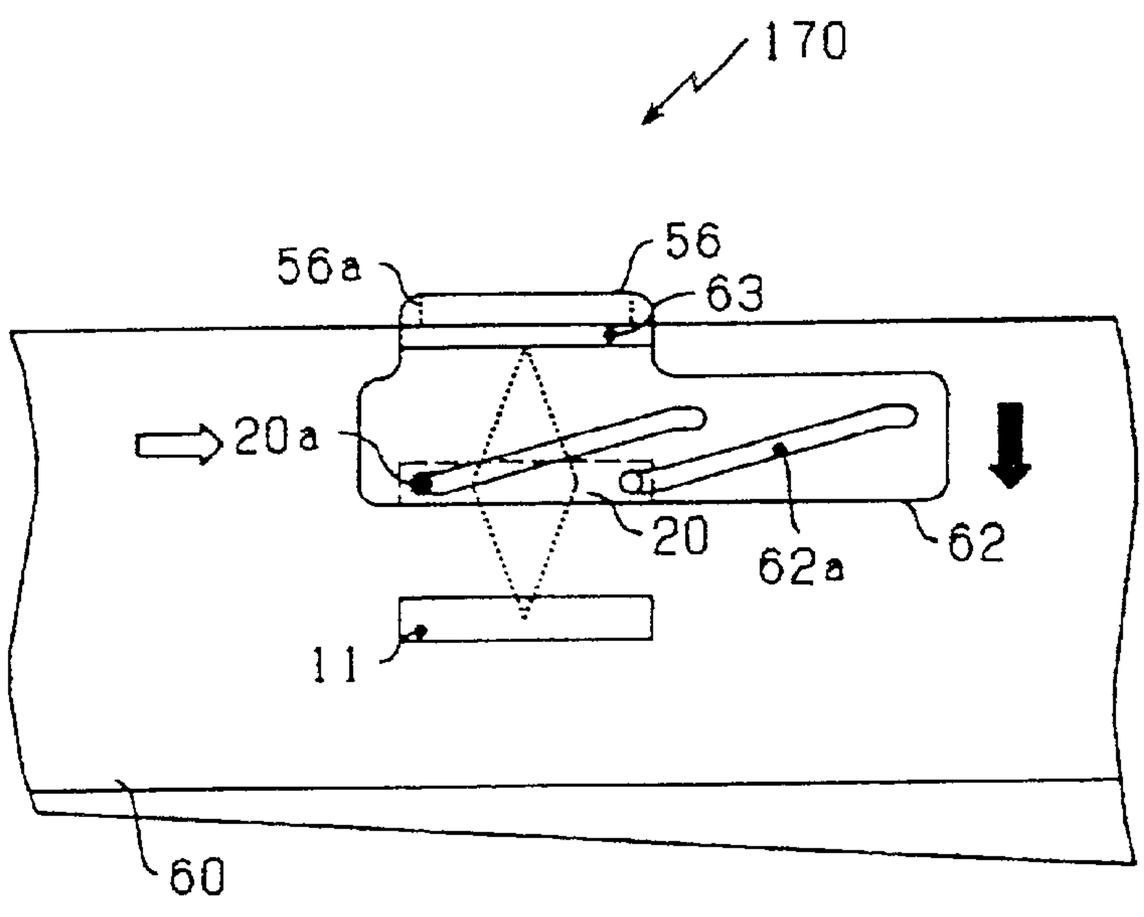

170
56a
56
63
20a
20
62a
62
11
60

FIG. 26

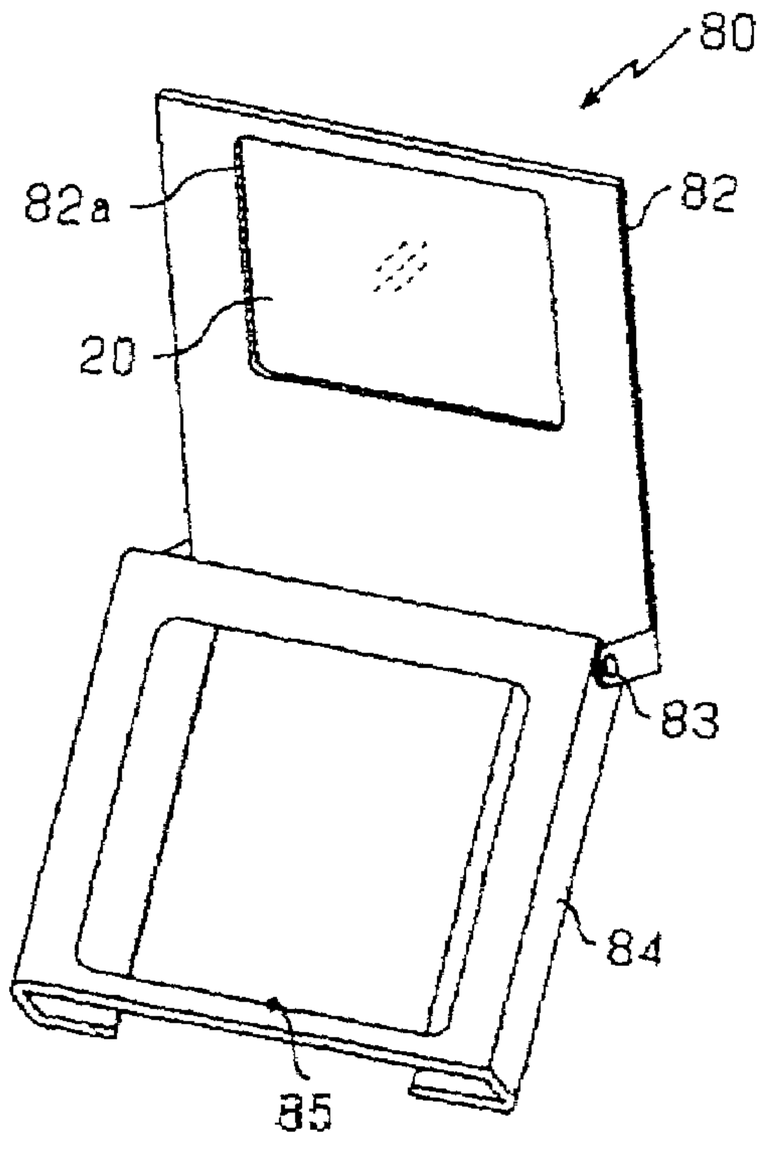


FIG. 27

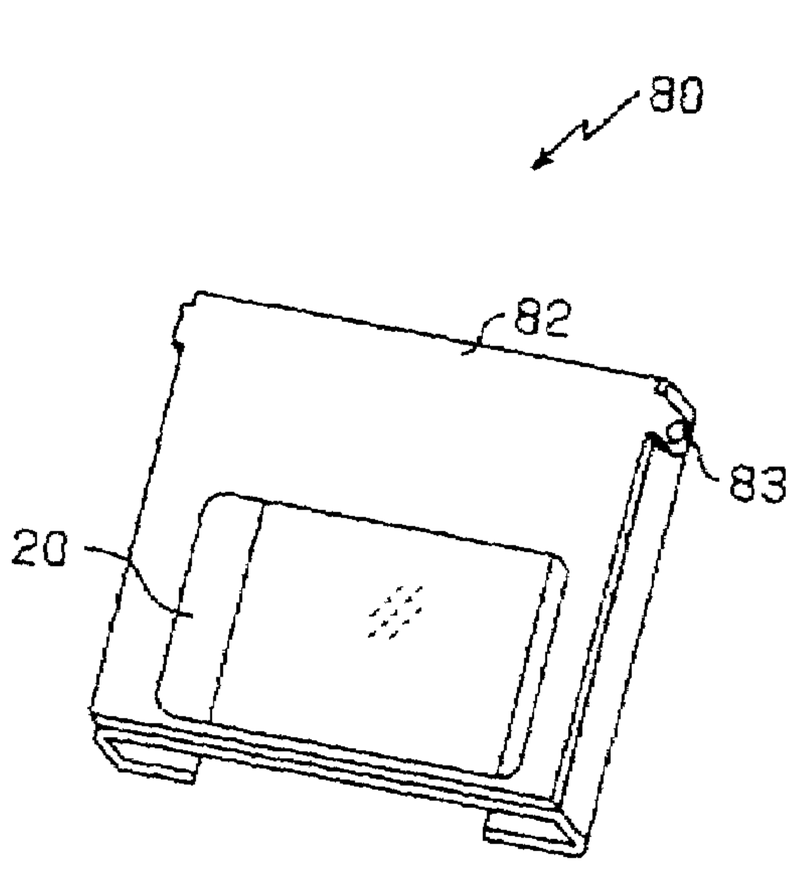


FIG. 28

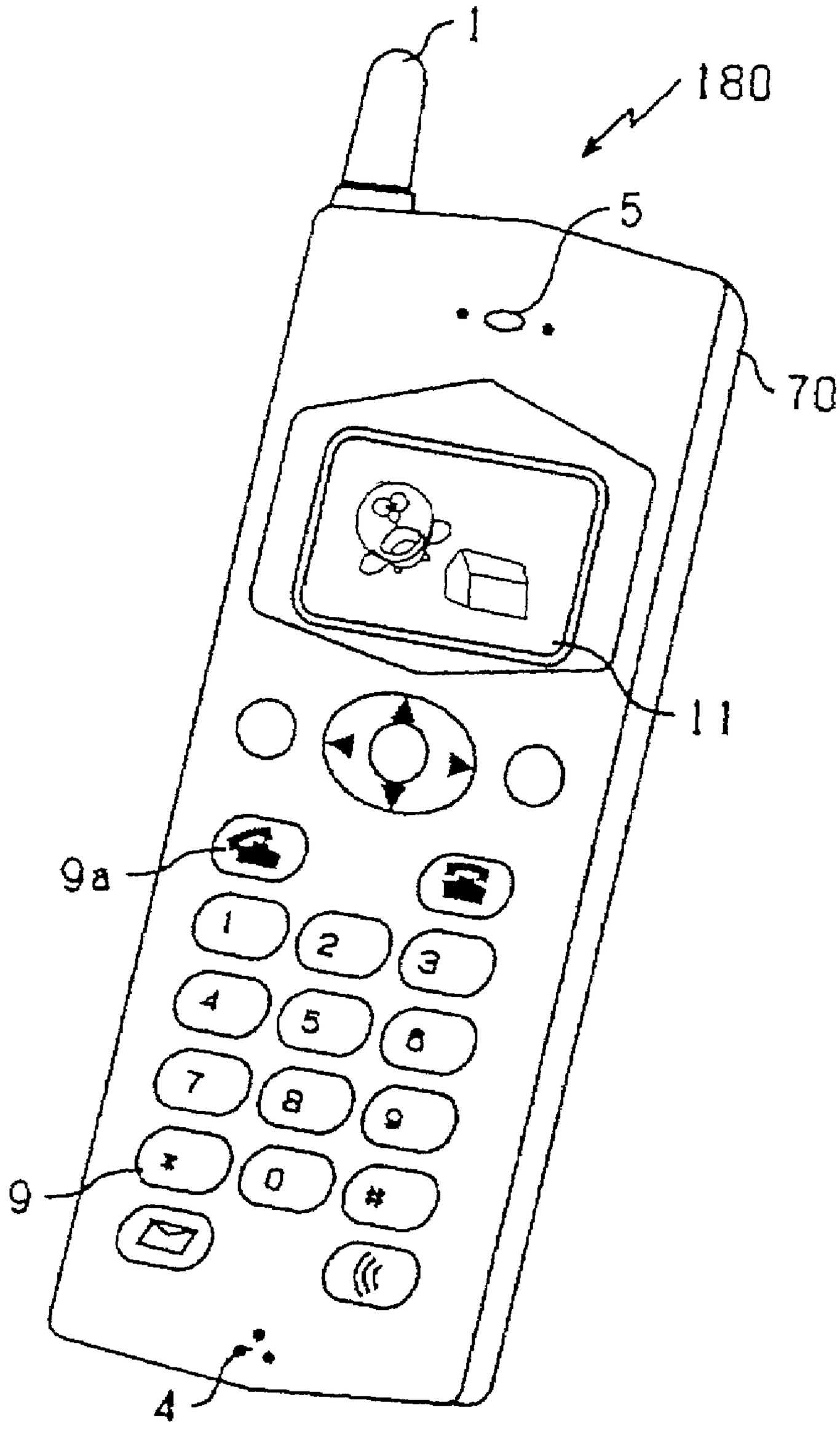


FIG. 29

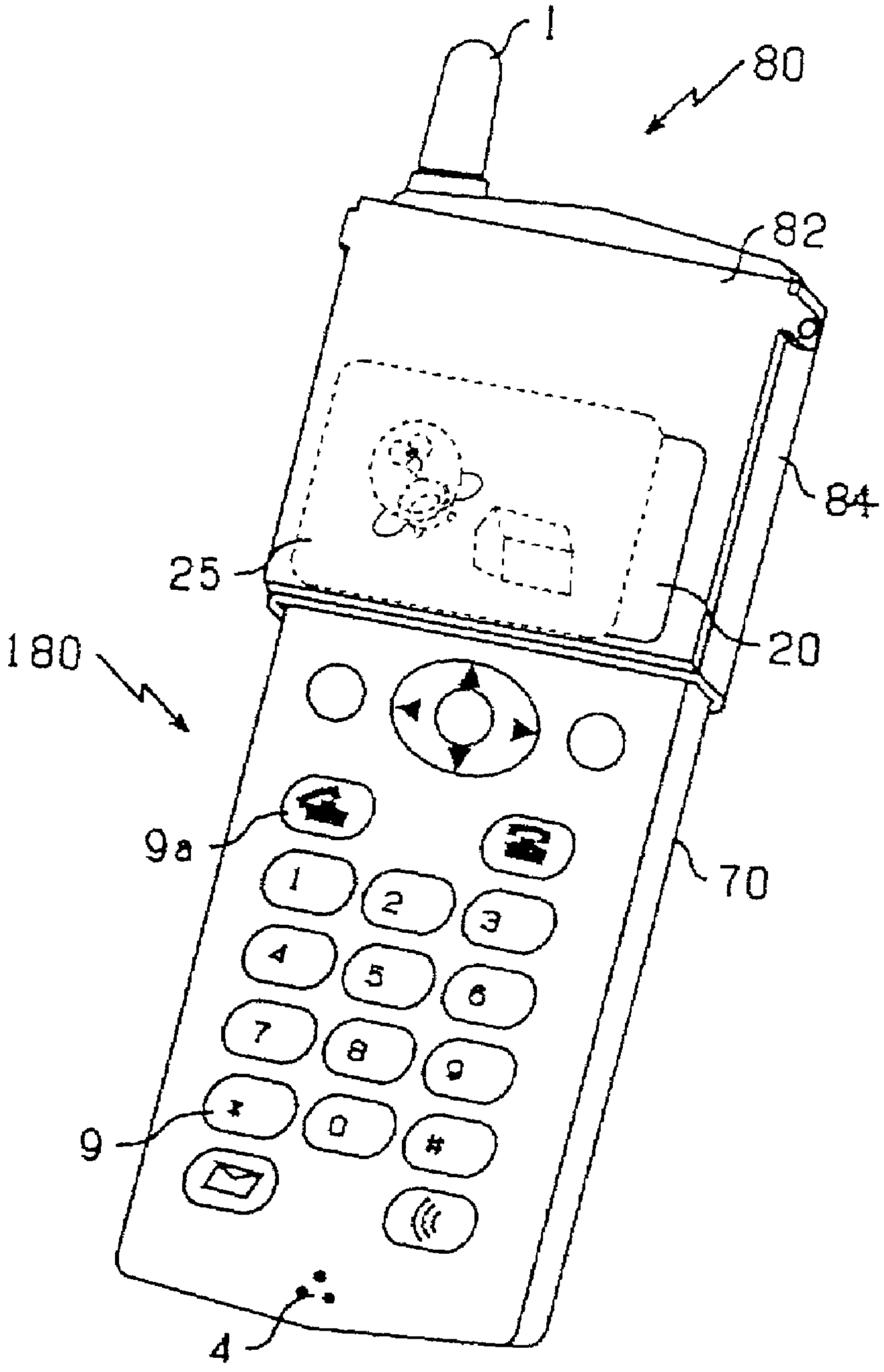
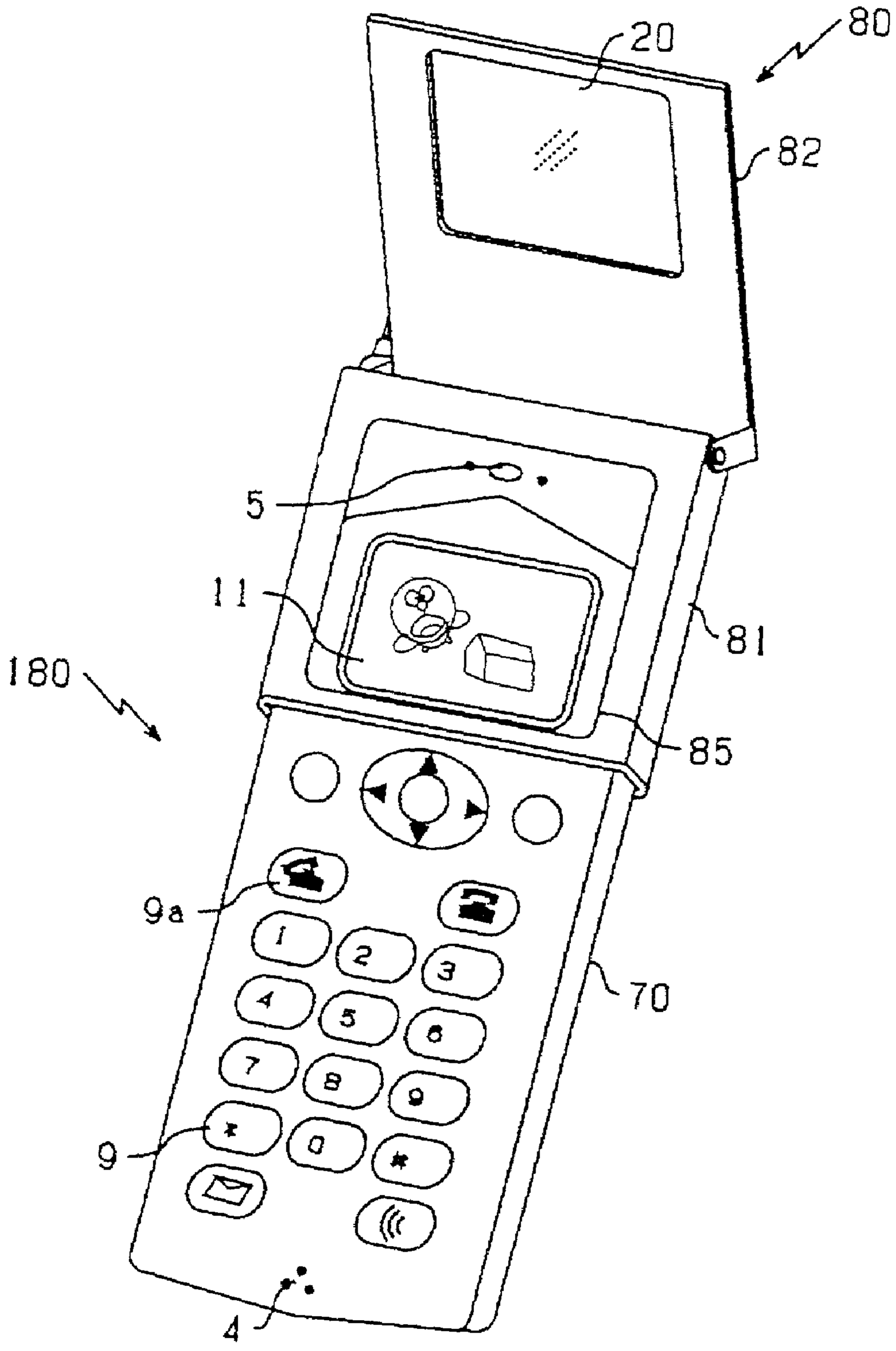


FIG. 30



COMMUNICATION TERMINAL DEVICE AND LENS ADAPTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a communication terminal device and a lens adapter to be used in a general-use communication terminal device.

2. Description of Related Art

Nowadays, communication terminal devices, especially portable telephones (cellular phones) are widespread, and the diffusion of those portable telephones is larger than the fixed telephones. Particularly, recent portable telephones have not only the basic functions to directly talk to the speaker or enjoy taking, but also the function to send the message in the form of character information and/or to display information uploaded on the internet (e.g., the game, the movies or concerts showing) Further, some portable telephones can display character pictures such as animations or photos of idols on its display unit, thereby giving the user pleasure at the time of phone call.

However, the conventional portable telephones display such pictures in a two-dimensional manner on the display unit of a color LCD (Liquid Crystal Display) or an organic EL (ElectroLuminescence) panel, and hence it is difficult to give pleasure or enjoyable feeling to the user by its display manner.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a communication terminal device capable of visualizing pictures displayed on a display unit in a pseudo-stereoscopic manner, thereby to give users pleasure or enjoyable feeling.

It is another object of the present invention to provide a lens adapter to be used with a general-use communication terminal device to enable the above pseudo-stereoscopic display.

According to one aspect of the present invention, there is provided a communication terminal device including: a display unit for displaying two-dimensional picture; a microlens unit including a pair of microlens arrays; a panel unit for supporting the microlens unit and being movable between a first position at which the microlens unit confronts the display unit with a spacing substantially equal to a focal length of the microlens unit and a second position at which the microlens unit does not confront the display unit.

In accordance with the communication device, the display unit displays two-dimensional picture. When the panel unit is at the first position, the microlens unit confronts the display unit with the spacing substantially equal to the focal length of the microlens unit. Therefore, the two-dimensional picture is visualized as a pseudo-stereoscopic picture. On the other hand, when the panel unit is at the second position, the microlens unit does not confront the display unit, and hence a user can directly see the two-dimensional picture on the display unit.

The panel unit may cover at least a part of an operation unit provided on the communication terminal device when the panel unit is at the first position.

The panel unit may be supported by the communication terminal device in such a manner that the panel unit can be opened and closed, and at least one of an operation unit and a microphone may be arranged on an inner face of the communication terminal device.

According to another aspect of the present invention, there is provided a communication terminal device including: a display unit for displaying two-dimensional picture; a microlens unit including a pair of microlens arrays and positioned to confront the display unit; a screen; and a panel unit for supporting the screen and being movable between a first position at which the screen confronts a face of the microlens unit on the opposite side of the display unit and a second position at which the screen does not confront the display unit.

In accordance with the communication terminal device, the display unit displays the two-dimensional picture. The panel unit supporting the screen is movable between the first position and the second position. When the screen is at the first position, the screen confronts the display unit and shows the two-dimensional picture projected on the screen to the user. On the other hand, when the screen is at the second position, the screen does not confront the display unit, and hence the microlens unit visualizes the two-dimensional picture displayed on the display unit as a pseudo-stereoscopic picture.

The panel unit may cover at least a part of an operation unit provided on the communication terminal device when the panel unit is at the second position.

According to still another aspect of the present invention, there is provided a communication terminal device including: a display unit for displaying two-dimensional picture; a microlens unit including a pair of microlens arrays and positioned to confront the display unit; a drive unit for moving the microlens unit with respect to the display unit to establish a first state in which the microlens unit and the display unit are remote from each other by a focal length of the microlens unit and a second state in which microlens unit and the display unit are in close contact with each other.

In accordance with the communication terminal device, the display unit displays the two-dimensional picture. When the microlens unit is in the first state, the microlens unit and the display unit are remote from each other by the focal length, so the microlens unit visualizes the two-dimensional picture on the display unit as a pseudo-stereoscopic picture. On the other hand, when the microlens unit is in the second state, the microlens unit and the display unit are in close contact with each other, and hence the two-dimensional picture on the display unit is shown to the user as it is.

The communication terminal device may further include a panel unit movable between a first position at which the panel unit covers at least a part of an operation unit provided on the communication terminal device and a second position at which the panel unit does not cover the operation unit. The drive unit may move the microlens unit with respect to the display unit to change the microlens unit and the display unit from the first state to the second state according to a movement of the panel unit from the first position to the second position.

The communication terminal device further including a screen positioned in front of a face, opposite to the display unit, of the microlens unit in the first state with a spacing smaller than the focal length.

According to still another aspect of the present invention, there is provided a communication terminal device including: a display unit for displaying two-dimensional picture; a microlens unit including a pair of microlens arrays; a screen positioned to confront a face of the microlens unit on the opposite side of the display unit; and a drive unit for moving the microlens unit with respect to the display unit to establish a first state, in which the microlens unit is remote from the display unit by a focal length of the microlens unit and

an image forming plane of the microlens unit is positioned over the screen in the first position, and a second state, in which the microlens unit is positioned at a middle of the display unit and the screen.

In accordance with the communication terminal device, the display unit displays the two-dimensional picture. The drive unit moves the microlens unit with respect to the display unit between the first state and the second state. In the first state, the microlens unit is remote from the display unit by the focal length and the image formation plane of the microlens unit is positioned over the screen. Therefore, the two-dimensional picture on the display unit is visualized as a pseudo-stereoscopic picture. On the other hand, in the second state, the microlens unit is positioned at the middle of the display unit and the screen. Therefore, the two-dimensional picture is projected on the screen.

The communication terminal device may further include a panel unit movable between a first position at which the panel unit covers at least a part of an operation unit provided on the communication terminal device and a second position at which the panel unit does not cover the operation unit, wherein the drive unit moves the microlens unit to be close to the display unit to change the microlens unit and the display unit from the first state to the second state according to a movement of the panel unit from the first position to the second position.

According to still another aspect of the present invention, there is provided a lens adapter including: an attachment unit for detachably attaching the lens adapter to a communication terminal device having a display unit for displaying two-dimensional picture; and a microlens unit including a pair of microlens arrays and positioned to confront the display unit with a spacing substantially equal to a focal length of the microlens unit when the lens adapter is attached to the communication terminal device.

In accordance with the lens adapter, the lens adapter may be attached to the communication terminal device by the attachment unit in a detachable manner. The communication terminal device has the display unit which displays two-dimensional picture. When the lens adapter is attached to the communication terminal device, the microlens unit confronts the display unit with the spacing of the focal length, and hence the microlens unit visualizes the two-dimensional picture on the display unit as a pseudo-stereoscopic picture.

The lens adapter may further include a panel unit for supporting the microlens unit and being movable between a first position at which the microlens unit confronts the display unit and a second position at which the microlens unit does not confront the display unit.

The nature, utility, and further features of this invention will be more clearly apparent from the following detailed description with respect to preferred embodiment of the invention when read in conjunction with the accompanying drawings briefly described below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing a configuration of a portable telephone according to embodiments of the present invention;

FIG. **2** is a side view of a microlens unit used in the present invention;

FIG. **3** is a plan view of the microlens unit used in the present invention;

FIG. **4** is an explanatory diagram illustrating picture display method when the microlens unit is in close contact with a display unit;

FIG. **5** is a perspective view showing the portable telephone according to a first embodiment in an in-use state;

FIG. **6** is a perspective view of the portable telephone according to the first embodiment in a call-waiting state;

FIG. **7** is a sectional view of the portable telephone according to the first embodiment by line A—A shown in FIG. **6**;

FIG. **8** is a flowchart showing telephone number registering operation;

FIG. **9** is a flowchart showing character picture display operation;

FIG. **10** is a perspective view of the portable telephone according to a second embodiment in an in-use state;

FIG. **11** is a perspective view of the portable telephone according to the second embodiment in a call-waiting state;

FIG. **12** is a perspective view of the portable telephone according to a third embodiment in an in-use state;

FIG. **13** is a perspective view of the portable telephone according to the third embodiment in a call-waiting state;

FIG. **14** is a perspective view of the portable telephone according to a fourth embodiment in an in-use state;

FIG. **15** is a perspective view of the portable telephone according to the fourth embodiment in a call-waiting state;

FIG. **16** is a perspective view of the portable telephone according to a fifth embodiment in an in-use state;

FIG. **17** is a sectional view of the portable telephone according to the fifth embodiment by line B—B in FIG. **16**;

FIG. **18** is a perspective view of the portable telephone according to the fifth embodiment in a call-waiting state;

FIG. **19** is a sectional view of the portable telephone according to the fifth embodiment by line C—C in FIG. **18**;

FIG. **20** is a magnified sectional view of a portion of the portable telephone according to the sixth embodiment in a call-waiting state;

FIG. **21** is a magnified sectional view of a portion of the portable telephone according to the sixth embodiment in an in-use state;

FIG. **22** is a magnified sectional view of a portion of the portable telephone according to the seventh embodiment in a call-waiting state;

FIG. **23** is a magnified sectional view of a portion of the portable telephone according to the seventh embodiment in an in-use state;

FIG. **24** is a magnified sectional view of a portion of the portable telephone according to the eighth embodiment in a call-waiting state;

FIG. **25** is a magnified sectional view of a portion of the portable telephone according to the eighth embodiment in an in-use state;

FIG. **26** is a perspective view of a lens adapter according to a ninth embodiment in an opened state;

FIG. **27** is a perspective view of a lens adapter according to the ninth embodiment in a closed state;

FIG. **28** is a perspective view of the portable telephone to which the lens adapter according to the ninth embodiment may be attached;

FIG. **29** is a perspective view of the portable telephone to which the lens adapter according to the ninth embodiment is attached and the panel unit of which is opened; and

FIG. **30** is a perspective view of the portable telephone to which the lens adapter according to the ninth embodiment is attached and the panel unit of which is closed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will now be described below with reference to the attached drawings.

The embodiments of the present invention are directed to the portable telephone and the lens adapter which visualize the two-dimensional character picture (e.g., moving picture of game, animation or still picture of idol) in a pseudo-stereoscopic manner.

[1st Embodiment]

The portable telephone **100** according to the first embodiment of the present invention has the circuit configured as shown in the block diagram of FIG. **1**. The configuration of the circuit of the portable telephone **100** will be described below with reference to FIG. **1**.

The portable telephone **100** includes an antenna **1**, a transceiver unit **2** for receiving the radio wave from relay stations and transmitting the radio wave to the relay stations, a low-frequency amplifier **3** for amplifying a demodulated signal, a microphone **4** for collecting voices of a user, a speaker **5** for outputting voices, a controller **6** for the total control of the portable telephone **100**, a RAM (Random Access Memory) **7** for storing telephone numbers and character pictures, a ROM (Read Only Memory) **8** for storing operation programs, an operation unit **9** which the user operates for making telephone call or registering the character pictures, a display unit **11**, a drive circuit **10** for driving the display unit **11**, and a microlens unit **20** for visualizing the character pictures displayed on the display unit **11** in a pseudo-stereoscopic manner.

Next, the configuration of the microlens unit **20** will be described with reference to FIGS. **2** to **4**. The microlens unit **20** has two microlens arrays **21** having the same configuration. As shown in FIGS. **2** and **3**, the microlens array **21** includes a transparent substrate **22** made by glass or acrylic plate having high translucent property, and a plurality of micro-convex lenses **23** having the same radius of curvature and being arranged in alignment with each other in a matrix manner on both sides of the transparent substrate **22**. The optical axes **24** of the micro-convex lenses arranged on both sides of the substrate **22** coincide with each other. Two microlens arrays **21** are positioned side by side in such a manner that the optical axes **24** of the micro-convex lenses **23** on each lens array **21** coincide with each other. The microlens unit **20** is configured in this fashion.

When the microlens unit **20** is positioned in front of the display unit **11** in a manner being parallel with the front face of the display unit **11** and with the spacing L nearly equal to the focal length of the convex lens **23**, the microlens unit **20** projects the picture displayed on the display unit **11** on an imaginary image formation plane **25** remote from the microlens unit **20** by the spacing nearly equal to the focal length L on the opposite side of the display unit **11** (on the right side in FIG. **2**). While the picture thus projected is a two-dimensional picture, if the picture has depth component (i.e., stereoscopic or three-dimensional), the picture is visualized in a manner floating on the space and is seen by the user as stereoscopic picture. Hereinafter, the two-dimensional picture visualized on the imaginary image formation plane **25** will be referred to as "pseudo-stereoscopic picture".

It is noted that the two-dimensional picture displayed on the display unit **11** is inverted by one microlens array **21** when passing therethrough, and is again inverted by the other microlens array **21** when passing therethrough. So, it is seen at the imaginary image formation plane **25** in a normal manner.

As described above, when positioned in front of the display unit **11** with the spacing nearly equal to its focal length, the microlens unit **20** visualizes the two-dimensional picture displayed on the display unit **11** on the imaginary image formation plate **25** as pseudo-stereoscopic picture. However, when positioned close to the display unit **11** as shown in FIG. **4**, the microlens unit **20** simply passes the two-dimensional picture on the display unit **11** as it is.

Next, the configuration of the foldable potable telephone **100** according to the first embodiment will be described with reference to FIGS. **5** to **7**. FIG. **5** is a perspective view of the portable telephone **100** in an in-use state, FIG. **6** is a perspective view of the potable telephone **100** in a call-waiting state, and FIG. **7** is a sectional view of the portable telephone **100** according to the line A—A in FIG. **6**.

The portable telephone **100** has a foldable structure in which a body unit **30** and a panel unit **31** are swingably connected to each other by a hinge portion **32**. The antenna **1**, the display unit **11**, the speaker **5** and the plurality of operation buttons **33** including function keys are arranged on the body unit **30**. The display unit **11** is a flat display such as a color LCD panel or an organic EL panel, and is attached to the body unit **30** such that the display surface is positioned at the same plane as the inner surface of the body unit **30** (facing the panel unit **31**).

The panel unit **31** is provided with the operation buttons **9** such as ten-keys on its inner face (confronting the body unit **30**) and the microphone **4**, and the microlens unit **20** is put in the opening window **34**.

When the panel unit **31** is positioned at the folded position (first position) to cover the operation buttons **9** and **33** as shown in FIG. **7**, the microlens unit **20** is located at the position remote from the display unit **11** by the focal length L. As described above with reference to FIG. **2**, when positioned remotely from the display unit **11** by the focal length L, the microlens unit **20** forms the imaginary image formation plane **25** at the position remote from the surface of the microlens unit **20** by the focal length L, on the side opposite to the display unit **11**. Therefore, in the folded state, i.e., in the call-waiting state, the portable telephone **100** can visualize the two-dimensional picture such as character picture displayed on the display unit **11** at the imaginary image formation plane **25** formed by the microlens unit **20** as the pseudo-stereoscopic picture.

On the other hand, when the panel unit **31** is at the opened position (second position) as shown in FIG. **5**, i.e., when the user is registering the telephone number or talking, the microlens unit **20** is moved to the position at which the display unit **11** is not covered. Therefore, the display unit **11** of the portable telephone **100** is exposed to the user, and the user can directly read the information displayed on the display unit **11**.

Next, the operation of registering telephone number for the portable telephone **100** will be described with reference to FIGS. **1** and **8**. FIG. **8** is a flowchart showing the telephone number registering operation, the program of which is stored in the ROM **8** in advance as the telephone number registering program.

The portable telephone **100** stores stereoscopic (three-dimensional) character pictures (such as still pictures and animation pictures) in the RAM **7**. When the user opens the panel unit **31** and presses the button **33** assigned to the telephone number registration, the controller **6** of the portable telephone **100** automatically executes the telephone

number registering program shown in FIG. **8**. First, the controller **6** performs telephone number setting control in step S**1**. Specifically, the controller **6** reads out the character information "NAME?" stored in the ROM **8**, and displays "NAME?" on the display unit **11**. When the user inputs a person's name by the ten-keys **9** and presses the enter button "#", the controller **6** displays "PHONE No.?" on the display unit **11**. When the user inputs the telephone number of the person including the area code and presses the enter button "#", the controller **6** goes to step S**2** to select character.

In Step S**2**, the controller **6** displays "CHARACTER?" and a plurality of character names to be selected on the display unit **11**. When the user selects a character and presses the enter button "#", the controller **6** goes to step S**3**. In step S**3**, the controller **6** registers the "NAME", "PHONE No." and the selected character name into the RAM **7** in the linked manner. Then, the controller **6** determines whether or not the user made the operation to finish the telephone number registering operation in step S**4**. If step S**4** results in NO, the controller **6** returns to step S**1** to repeat the above described steps. On the other hand, if step S**4** results in YES, the controller **6** finishes the telephone number registering program.

Next, the character display operation by the portable telephone **100** at the time of phone-call will be described with reference to FIGS. **1** and **9**. FIG. **9** shows the flowchart of the character display operation, the program of which is stored in the ROM **8** in advance as the character display operation program.

The portable telephone **100** receives the radio wave captured by the antenna **1** via the transceiver unit **2**, and amplifies and demodulates the radio wave. Out of the demodulated signals, the audio signal is amplified by the low-frequency amplifier **3** and outputted by the speaker **5**. Out of the demodulated signals, the character data such as the telephone number of the caller and/or the message are supplied to the controller **6**. The transceiver unit **2** has a signal detection circuit (not shown) which outputs a DC voltage when it receives the radio wave. The controller **6** displays the signal intensity on the display unit **11** and determines whether or not the portable telephone **100** is in the radio wave receiving state, by using the output signal of the signal detection circuit.

In the call-waiting state, the controller **6** performs the operation control according to the flowchart shown in FIG. **9**. First, the controller **6** detects the call-receiving state in step S**10**. When the call is detected (step S**10**;YES), the controller **6** goes to step S**11**. In step S**11**, the controller **6** extracts the character information such as the caller's telephone numbers and the messages from the demodulated signals and stores them into the RAM **7**, and then goes to step S**12**. In step S**12**, the controller **6** determines whether or not the caller's telephone number is registered in the RAM **7**. If step S**12** results in NO, the controller **6** generates call melody indicating a phone call from a sound source or the like (not shown), and then ends the character display operation program.

On the other hand, if the controller **6** determines that the caller's telephone number is registered in the RAM **7** (step S**12**;YES), the controller **6** goes to step S**13**. The controller **6** reads out the character picture data linked with the caller's telephone number thus detected, and controls the drive circuit **10** to display the character picture on the display unit **11**. Then, the controller **6** generates the call melody indicating a phone call in step S**14**, and ends the character display operation program.

As described above, according to the portable telephone **100** of the present invention, the microlens unit **20** is positioned in front of the display unit **11** when the panel unit **31** is in the folded position (i.e., in the call-waiting state) shown in FIG. **6**. Therefore, when the portable telephone **100** displays the character picture on the display unit **11** after receiving the call, the character picture is visualized by the microlens unit **20** as a pseudo-stereoscopic picture, thereby giving the user pleasure or enjoyable feeling at the time of phone call.

On the other hand, when the panel unit **31** is in the first position (i.e., in-use position) as shown in FIG. **5**, the panel unit **31** is opened so that the microlens unit **20** is moved to the position not to cover the display unit **11**. Therefore, the display unit **11** of the potable telephone **100** is exposed to provide the user with the normal, two-dimensional picture. The display unit **11** of the portable telephone **100** displays the telephone number and the like, which are not needed and suitable to be displayed in the pseudo-stereoscopic manner, thereby avoiding the user's eyestrain.

In the above portable telephone **100**, the character picture displayed at the time of phone-call is visualized as the pseudo-stereoscopic picture. However, the game picture may be displayed on the display unit **11** by the manipulation of the operation button **31** provided on the outer surface of the panel **31** so that the user can enjoy the game with seeing the game picture in the pseudo-stereoscopic manner in the state that the panel unit **31** is folded.

Next, other embodiments of the present invention will be described below. It is noted that the circuit configuration of the portable telephones described below are identical to that of the portable telephone **100** of the first embodiment, and hence the description thereof will be omitted.

[2nd Embodiment]

The configuration of the foldable portable telephone **110** according to the second embodiment will be described with reference to FIGS. **10** and **11**. FIG. **10** is a perspective view of the portable telephone **110** in the in-use state, and FIG. **11** is a perspective view of the portable telephone **110** in the call-waiting state.

As shown in FIG. **10**, the portable telephone **110** is configured by a body unit **40**, a first panel unit **41** and a second panel unit **42**. The antenna **1**, the display unit **11**, the speaker **5** and a plurality of function keys **44** are arranged on the body unit **40**. The first panel unit **41** is connected to the lower end of the body unit **40** by the hinge portion **43** such that the first panel unit **41** can be opened and closed, and the operation buttons **9** such as ten-keys and the microphone **4** are arranged on the inner face of the first panel unit **41** confronting the body unit **40**. On the other hand, the second panel unit **42** is connected to the upper end of the body unit **40** by a connecting portion (not shown) such that the second panel unit **42** can be opened and closed. The microlens unit **20** is attached in the opening window **42***a*. Therefore, the portable telephone **110** according to the second embodiment differs from the portable telephone **100** according to the first embodiment in that only the microlens unit **20** is attached to the body unit **40** in such a manner that it can be arbitrarily opened and closed, and other portions are configured in the same manner as those of the portable telephone **100** according to the first embodiment.

Therefore, according to the portable telephone **110**, when the panel units **41** and **42** are in the folded, second position (call-waiting state) as shown in FIG. **11**, the microlens unit **20** is positioned to confront the front face of the display unit **11**. By this, the portable telephone **110** visualizes the char-

acter picture at the time of phone call as a pseudo-stereoscopic picture, thereby giving the user pleasure or enjoyable feeling at the time of phone call. Further, according to the portable telephone **110**, since only the second panel unit **42** having the microlens unit **20** may be opened and closed, the user can, if desired, open only the second panel unit **42** to see the normal two-dimensional picture displayed on the display unit **11**.

On the other hand, when the panel units **41** and **42** are in the opened, first position (in-use state) as shown in FIG. **10**, the microlens unit **20** is moved to the position not to over the display unit **11**. Therefore, the portable telephone **110** exposes the display unit **11**, and provides the normal two-dimensional picture which is easy to see by the user.

[3rd Embodiment]

Next, the configuration of the slide-type portable telephone **120** according to the third embodiment of the present invention will be described with reference to FIGS. **12** and **13**. FIG. **12** is a perspective view of the portable telephone **120** in the in-use state, and FIG. **13** is a perspective view of the portable telephone **120** in the call-waiting state.

As shown in FIG. **12**, the portable telephone **120** is configured by the body unit **45** and the panel unit **46**, and the panel unit **46** is attached to the body unit **45** in a manner slidable in the direction of the arrow in FIG. **12**. The antenna **1**, the display unit **11**, the speaker **5**, the operation buttons **9** and the microphone **4** are arranged on the body unit **45**, and the microlens unit **20** and a plurality of function buttons **48** are arranged on the panel unit **46**. The portable telephone **120** according to the third embodiment differs from the portable telephones according to the first and second embodiment in that the panel unit **46** is attached to the body unit **45** in the slidable manner, and other portions are configured in the same manner.

Therefore, according to the portable telephone **120**, when the slidable panel units **46** is in the closed, second position (call-waiting state) as shown in FIG. **13**, the microlens unit **20** is positioned to confront the front face of the display unit **11**. By this, the portable telephone **120** visualizes the character picture at the time of phone call as a pseudo-stereoscopic picture, thereby giving the user pleasure or enjoyable feeling at the time of phone call.

On the other hand, when the slidable panel units **46** is in the pulled-down, first position (in-use state) as shown in FIG. **12**, the microlens unit **20** is moved to the position not to cover the display unit **11**. Therefore, the portable telephone **120** exposes the display unit **11**, and provides the normal two-dimensional picture which is easy to see by the user.

[4th Embodiment]

Next, the configuration of the slide-type portable telephone **130** according to the fourth embodiment of the present invention will be described with reference to FIGS. **14** and **15**. FIG. **14** is a perspective view of the portable telephone **130** in the in-use state, and FIG. **15** is a perspective view of the portable telephone **130** in the call-waiting state.

As shown in FIG. **14**, the portable telephone **130** is configured by the body unit **50** and the panel unit **51**, and the panel unit **51** is attached to the body unit **50** in a manner slidable along the groove **52** in the direction of the arrow in FIG. **14**. The antenna **1**, the display unit **11**, the speaker **5**, the operation buttons **9** and the microphone **4** are arranged on the body unit **50**, and the microlens unit **20** is attached to the opening window **51***a* of the panel unit **51**. The portable telephone **130** according to the fourth embodiment differs from the portable telephone **120** according to the third embodiment in that the panel unit **51** has only the microlens unit **20**, and other portions are configured in the same manner.

According to the portable telephone **130**, when the panel units **51** is in the closed, second position (call-waiting state) as shown in FIG. **15**, the microlens unit **20** is positioned to confront the front face of the display unit **11**. By this, the portable telephone **130** visualizes the character picture at the time of phone call as a pseudo-stereoscopic picture, thereby giving the user pleasure or enjoyable feeling at the time of phone call. Further, according to the portable telephone **130**, the user can, if desired, slide the panel **51** to see the normal two-dimensional picture displayed on the display unit **11**.

On the other hand, when the panel units **51** is in the pulled-up, first position (in-use state) as shown in FIG. **14**, the microlens unit **20** is moved to the position not to over the display unit **11**. Therefore, the portable telephone **130** exposes the display unit **11**, and provides the normal two-dimensional picture.

[5th Embodiment]

Next, the configuration of the slide-type portable telephone **140** according to the fifth embodiment of the present invention will be described with reference to FIGS. **16** to **19**. FIG. **16** is a perspective view of the portable telephone **140** in the in-use state, FIG. **17** is a sectional view of the portable telephone **140** at the B—B line in FIG. **16**, FIG. **18** is a perspective view of the portable telephone **140** in the call-waiting state, and FIG. **19** is a sectional view of the portable telephone **140** at the C—C line in FIG. **18**.

As shown in FIG. **16**, the portable telephone **140** is configured by the body unit **55** and the panel unit **56**. The panel unit **56** is attached to the body unit **55** in a manner slidable along the groove **57** in the direction of the arrow in FIG. **16**. The antenna **1**, the display unit **11**, the speaker **5**, the operation buttons **9**, the microphone **4** and the microlens unit **20** are arranged on the body unit **55**, and the screen **58** made of transparent acrylic plate is attached in the opening window **56***a* of the panel unit **56**.

As shown in FIG. **17**, the microlens unit **20** is at the position remote from the display unit **11** by the focal length L of the microlens unit **20**. When the panel unit **56** is at the upper position where it does not cover the operation buttons **9** on the body unit **55**, the screen **58** is at the position remote from the microlens unit **20** by the focal length L.

According to the portable telephone **140**, when the slidable panel unit **56** is in the pulled-down, second position (call-waiting state) as shown in FIGS. **18** and **19**, the portable telephone **140** visualizes the character picture at the time of phone call as a pseudo-stereoscopic picture at the imaginary image formation plane **25**, thereby giving the user pleasure or enjoyable feeling at the time of phone call.

On the other hand, when the panel unit **56** is in the pulled-up, first position (in-use state) as shown in FIGS. **16** and **17**, the screen **58** is at the position coincident with the imaginary image formation plane **25** formed by the microlens unit **20**. Therefore, the portable telephone **140** projects the picture on the display unit **11** on the screen **58**, and provides the normal two-dimensional picture in a manner easy to see by the user.

[6th Embodiment]

Next, the configuration of the portable telephone **150** according to the sixth embodiment of the present invention will be described with reference to FIGS. **20** and **21**. FIG. **20** is a magnified sectional view of a portion of the portable

telephone **150** in the call-waiting state, and FIG. **21** is a magnified sectional view of a part of the portable telephone **150** in the in-use state.

The portable telephone **150** has the appearance generally identical to that of the portable telephone **140** according to the fifth embodiment shown in FIG. **16**. The portable telephone **150** according to the sixth embodiment differs from the portable telephone **140** according to the fifth embodiment in that the screen **58** is not attached to the opening window **56***a* of the panel unit **56** and that the sliding plate **62** connected to the panel unit **56** moves the microlens unit **20** vertically upward and downward with respect to the display unit **11**.

Specifically, the pins **20***a* protruding from both sides of the microlens unit **20** are inserted into the oblique guide grooves **62***a* of the sliding plate **62** and the vertical guide slot of the guide plate (not shown). The guide grooves **62***a* of the sliding plate **62** are formed in a manner obliquely extending downward and leftward direction in FIGS. **20** and **21**, and the leftward-rightward movement of the sliding plate **62** moves the microlens unit **20** vertically upward and downward with respect to the display unit **11**.

According to the portable telephone **150**, when the panel unit **56** is at the first position (call-waiting position) covering a part of the operation unit of the body unit as shown in FIG. **20**, the microlens unit **20** is located at the position remote from the display unit **11** by the focal length by means of the sliding plate **62** (i.e., first position), and the portable telephone **140** visualizes the character picture at the time of phone call as a pseudo-stereoscopic picture at the imaginary image formation plane **25**, thereby giving the user pleasure or enjoyable feeling at the time of phone call.

On the other hand, when the panel unit **56** is pulled up to the second position at the upper area of the portable telephone by the user (i.e., in-use state) as shown in FIG. **21**, the microlens unit **20** moves to and closely contacts the display unit **11** by the cooperation with the sliding plate **62**. Therefore, the microlens unit **20** passes the picture on the display unit **11** to provide the normal two-dimensional picture in a manner easy to see by the user.

[7th Embodiment]

Next, the configuration of the portable telephone **160** according to the seventh embodiment of the present invention will be described with reference to FIGS. **22** and **23**. FIG. **22** is a magnified sectional view of a part of the portable telephone **160** in the call-waiting state, and FIG. **23** is a magnified sectional view of a part of the portable telephone **160** in the in-use state.

The portable telephone **160** according to the seventh embodiment differs from the portable telephone **150** according to the sixth embodiment in that the screen **63** is provided to the body unit **60** to cover the front face of the microlens unit **20**. By this, the microlens unit **20** is protected from possible scratch or dust.

According to the portable telephone **160**, when the panel unit **56** is at the first position (call-waiting position) covering a part of the operation unit of the body unit as shown in FIG. **22**, the microlens unit **20** is located at the position remote from the display unit **11** by the focal length by means of the sliding plate **62** (i.e., first position), and visualizes the character picture at the time of phone call as a pseudo-stereoscopic picture at the imaginary image formation plane **25**, thereby giving the user pleasure or enjoyable feeling at the time of phone call.

On the other hand, when the panel unit **56** is pulled up to the second position at the upper area of the portable telephone by the user (i.e., in-use state) as shown in FIG. **23**, the microlens unit **20** moves to and closely contacts the display unit **11** by the cooperation with the movement of the sliding plate **62** in the right direction in FIG. **23**. Therefore, the portable telephone **160** passes the two-dimensional picture on the display unit **11** through the microlens unit **20** and the screen **63** to provide the normal two-dimensional picture in a manner easy to see by the user.

[8th Embodiment]

Next, the configuration of the portable telephone **170** according to the eighth embodiment of the present invention will be described with reference to FIGS. **24** and **25**. FIG. **24** is a magnified sectional view of a part of the portable telephone **170** in the call-waiting state, and FIG. **25** is a magnified sectional view of a part of the portable telephone **170** in the in-use state.

The portable telephone **170** according to the eighth embodiment differs from the portable telephone **160** according to the seventh embodiment in that the movable range of the microlens unit **20** by the sliding plate **62** is changed. Namely, according to the portable telephone **160** of the seventh embodiment, the microlens unit **20** is moved between the position remote from the display unit **11** by the focal length (see. FIG. **22**) and the position in close contact with the display unit **11** (see. FIG. **23**). In contrast, according to the portable telephone **170** according to the eighth embodiment, the microlens unit **20** is moved between the position remote from the display unit **11** by the focal length (see. FIG. **24**) and the position at the middle of the screen **63** and the display unit **11** (see. FIG. **25**).

According to the portable telephone **170**, when the panel unit **56** is at the first position (call-waiting position) covering a part of the operation unit of the body unit as shown in FIG. **24**, the microlens unit **20** is located at the position remote from the display unit **11** by the focal length by means of the sliding plate **62** (i.e., first position), and visualizes the character picture displayed on the display unit **11** at the time of phone call as a pseudo-stereoscopic picture at the imaginary image formation plane **25** over the screen **63**, thereby giving the user pleasure or enjoyable feeling at the time of phone call.

On the other hand, when the panel unit **56** is pulled up to the second position at the upper area of the portable telephone **170** by the user (i.e., in-use state) as shown in FIG. **25**, the microlens unit **20** moves down to position at the middle of the screen **63** and the display unit **11** by the cooperation with the movement of the sliding plate **62** in the right direction in FIG. **25** (this is second position). Therefore, the portable telephone **170** projects the two-dimensional picture on the display unit **11** by the microlens unit **20** onto the screen **63** to provide the normal two-dimensional picture in a manner easy to see by the user.

[9th Embodiment]

Next, the configuration and using manner of the lens adapter **80** according to the ninth embodiment of the present invention will be described with reference to FIGS. **26** to **30**. FIG. **26** is a perspective view of the lens adapter **80** when the panel unit **82** is opened, FIG. **27** is a perspective view of the lens adapter **80** when the panel unit **82** is closed, FIG. **28** is a perspective view of the portable telephone **180** to which the lens adapter **80** can be attached, FIG. **29** is a perspective view of the portable telephone **180** when the lens adapter **80** is attached and the panel unit **82** is closed, and FIG. **30** is a perspective view of the portable telephone **180** when the lens adapter **80** is attached and the panel unit **82** is opened.

First, the configuration of the lens adapter **80** will be described. As shown in FIG. **26**, the lens adapter **80** includes the attachment unit **84** and the panel unit **82**. Both sides of the attachment unit **84** are folded so that it may be attached to a general-use portable telephone **180** as shown in FIGS. **29** and **30**. The attachment unit **84** has an opening window **85** by which the display unit **11** and the speaker **5** of the portable telephone **180** are exposed. On the other hand, the panel unit **82** has an opening window **82***a* to which the microlens unit **20** is attached. The panel unit **82** is attached to the attachment unit **84** by the hinge portion **83** such that the panel unit **82** can be opened and closed.

FIG. **28** illustrates the appearance of the portable telephone **180** to which the lens adapter **80** of this embodiment can be attached. The portable telephone **180** has the antenna **1**, the speaker **5**, the display unit **11**, the operation buttons **9** including the talk button **9***a*, and the microphone **4**. As shown in FIGS. **29** and **30**, the lens adapter **80** is attached to the portable telephone **180** from upper portion thereof.

When the panel unit **82** is at the closed, first position (i.e., call waiting position) as shown in FIG. **29**, the lens adapter **80** is located at the position remote from the display unit **11** by the focal length in parallel with the front face of the display unit **11**, and thereby visualizes the character picture displayed on the display unit **11** at the imaginary image formation plane **25** as the pseudo-stereoscopic picture to give the user pleasure or enjoyable feeling at the time of the phone call.

On the other hand, when the panel unit **82** is located at the second position (in-use state) at which the panel unit **82** is opened as shown in FIG. **30**, the lens adapter **80** exposes the display unit **11** and the speaker **5** of the portable telephone **180** by the opening window **85**, thereby providing normal two-dimensional picture to the user.

In the above lens adapter **80**, the microlens unit **20** is attached to the panel unit **82** which can be opened and closed. However, the microlens unit **20** may be attached into the opening window **85** of the attachment unit **84** so that the user can attach the lens adapter **80** to the portable telephone **180** only when he or she wants to see and enjoy the pseudo-stereoscopic picture.

The application of the present invention is not limited to the features described in the above embodiments. For example, while the above embodiments are directed to the application of the present invention to the portable telephone, the present invention may also be applied to a codeless telephone, a PHS telephone, a car telephone and other various communication terminal devices.

Further, while the microlens unit **20** is moved with respect to the display unit **11** by the movement of the sliding plate **62** in the sixth and seventh embodiments, the microlens unit **20** may be fixed to the call-waiting position and the display unit **11** may be vertically moved by the movement of the sliding plate **62**.

According to the present invention, the two-dimensional picture displayed on the display unit may be visualized as the pseudo-stereoscopic picture, and hence the user may have pleasure or enjoyable feeling.

What is claimed is:

1. A lens adapter comprising:

an attachment unit for detachably attaching the lens adapter to a communication terminal device having a display unit for displaying two-dimensional picture;

an opening window formed on the attachment unit at a position confronting the display unit when the lens adapter is attached to the communication terminal device;

a microlens unit including a pair of microlens arrays and positioned to confront the display unit with a spacing substantially equal to a focal length of the microlens unit when the lens adapter is attached to the communication terminal device; and

a panel unit for supporting the microlens unit and attached to the attachment unit in a manner movable between a first position at which the microlens unit confronts the display unit and a second position at which the microlens unit does not confront the display unit.

2. A lens adapter according to claim **1**, wherein the attachment unit has folded parts at both sides thereof, and the attachment unit is attached to the communication terminal device by the folded parts.

3. A lens adapter according to claim **1**, the communication terminal device is received by the folded parts of the attachment unit when the lens adapter is attached to the communication terminal device.

4. A lens adapter according to claim **1**, wherein the opening window exposes the display unit and a speaker of the communication terminal when the lens adapter is attached to the communication terminal device.

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